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ON CERTAIN CONTRIVANCES FOR CROSS-FERTILIZATION IN FLOWERS.

BY PROF. J. E. TODD.

SINCE the first announcement of the principle of cross-fertilization, by Darwin, many most interesting and instructive examples have been noted and published, but the field is by no means exhausted.

Some ingenious contrivances for cross-fertilization are charmingly described by Prof. Gray in his little work "How Plants Behave," which he published a few years since as earnest of a larger work, which, we hope, may be soon forthcoming. One as wonderful as any is the Iris. His description applies nearly equally well to any species of that beautiful genus. His figure, perhaps, is open to slight criticism; the pistil is too erect and the stigma, therefore, too high above the sepal to illustrate its function to the best advantage. The position given is sometimes observed after the pistil is fertilized, but before that the pistil turns down so close to the sepal that a large bee in entering *must* touch the stigma with his back, which has been powdered with pollen while working in some previously visited flower (Fig. 1). Not stopping, however, to repeat what has been so well stated before, I would simply call attention to one point which I think is worthy of mention, viz: the plush-like "crest" of the

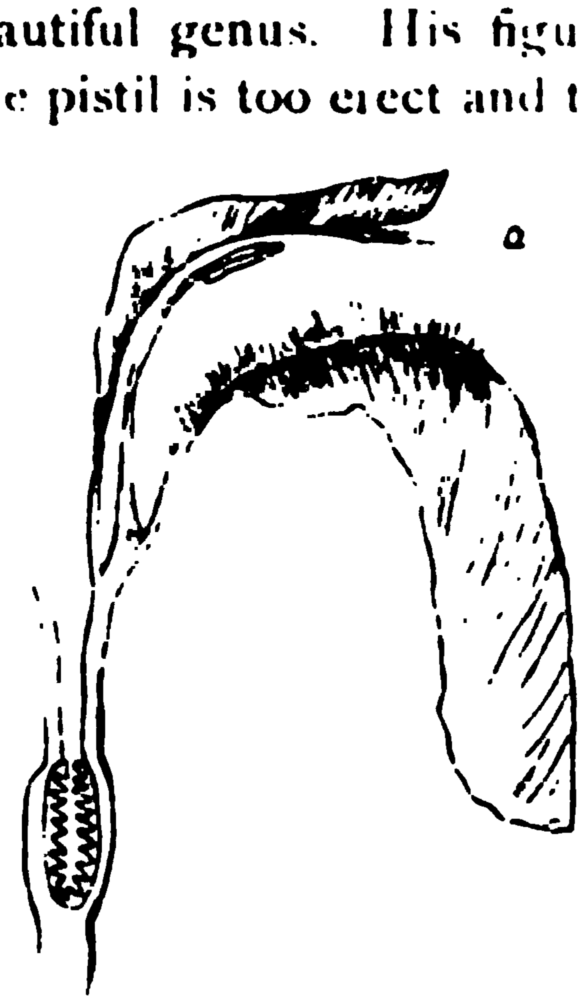

FIG. 1.—A section of portion of an Iris flower. *a*, stigma.

sepal. Is it not well adapted for tripping the smaller insects, or raising them, so that they shall hit the stamen and stigma, forcing them by increased activity, or by their walking on its top, to compensate for lack of size? In this arrangement of parts in the Iris we have the main features of a plan which is traceable in many other flowers.

Strangely enough many *irregular monopetalous* corollas seem to copy this *regular polypetalous* one in its method of cross-fertilization. This is especially true of *Martynia proboscidea* Glox., the unicorn plant. The general form and structure of the flower is shown in the figures. The lower petal forms a broad platform upon which the bee alights. As it enters the tube (which I believe is broader before fertilization, the roof rising as the corolla fades), it first brushes the lower lip of the stigma, Fig. 3 *a*, then while getting the nectar at the bottom of the tube its back is dusted by the anthers. As it withdraws, the flexible lobe of the pistil, like a valve, allows the pollen to pass without touching the stigma, which is on its upper or inner surface. This lower lobe is very sensitive before fertilization, during which time it hangs nearly vertical. In the case of a flower kept for examination, as soon as it was touched with a mass of pollen it rose toward the upper lobe so rapidly that its motion was very perceptible.

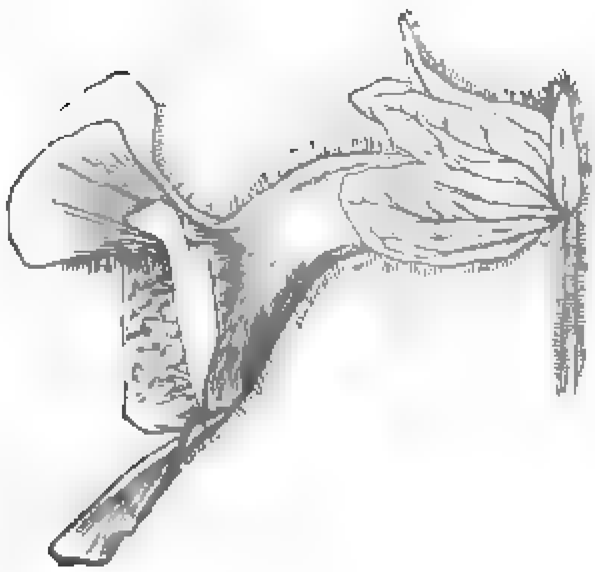

FIG. 2.—Side view of *Martynia proboscidea*. (Natural size.)

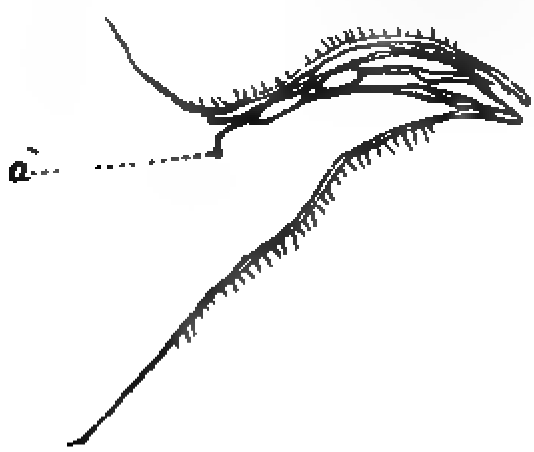

FIG. 3.—Cross-section of *Martynia proboscidea* showing arrangement of pistil and stamens. *a*, flexible lobe of stigma as before fertilization.

In the Penstemons (my observations are mainly upon one species, *P. glaucus* [?] Grah.[1]), we

[1] The notes presented were made last June on a species occurring abundantly in Central Nebraska. The species was not familiar to me: I made a hasty sketch of the flower as given. Certain notes of the characters of the plant were taken, but not enough to decisively distinguish it from the many species of the same genus occurring in that region.

have another slight variation of the plan. The corolla tube is broad and large. On the upper side are the four anthers in two pairs, and above them, or back of them, the pistil with undivided stigma. Before the anthers discharge their pollen the style is straight lying close to the upper side of the tube. While the pollen ripens and is discharging, the style elongates, and its end, after passing the longer stamens, turns abruptly downward. This position is not usually taken till the pollen is all gone from the flower. This arrangement brings the stigma right in the way of any insect entering the flower, and scrapes from it the pollen it may have received from some neighboring flower in which the stamens are discharging pollen.

Fig. 4. — *Pentstemon glaucus* ?. Side view. (Natural size.)

Fig. 5.—Cross-sections of the same: *a*, staminate stage; *b*, pistillate stage.

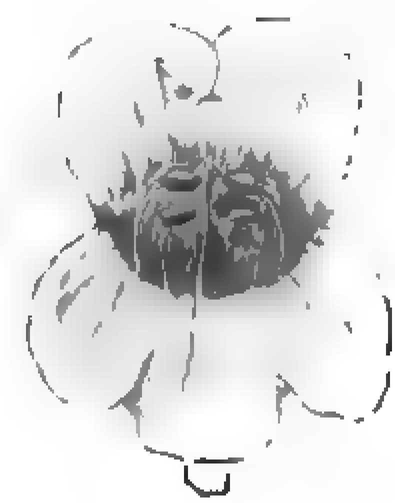

Fig. 6.—Front view of the same after discharge of pollen.

The following table, showing relative development of pistil and stamens in *P. glaucus*, gives full authority for the above statements:

	Anthers discharged.	Partly discharged.	Closed.
Pistils straight..................	0	7	27
" curved	21	17	1

It is to be regretted that the degree of curvature of the pistil was not more carefully noted; it may be said, however, that

generally it was considerably less when the pollen was partially discharged, than when it was entirely discharged.

We see very clearly, therefore, how the later development of the pistil with the curving of the style in this case accomplishes the same end as the flexible bi-lobed stigma placed in front of the stamens, as in the *Martynia*.

It is very interesting to find in the lower side of the tube, in the Penstemon, the fifth stamen, which is sterile and *bristling* with hairs, serving the same purpose, apparently, as the crested sepal in the Iris.

In the *Gladiolus* a relation of pistil to stamens is found similar to that in the Penstemon, while in several of the *Labiatæ* we find both the valve-like arrangement of the stigma and the later lengthening and bending of the style.

In *Lobelia syphilitica* L., as probably in all the Lobelias, we find a very different arrangement, but accomplishing the same result, viz: cross-fertilization of the plant.

The corolla is monopetalous and two-lipped, the lower lip consisting of three petals and the upper of two. Between the latter is a slit extending to the base of the tube. The five stamens are free from the corolla and united, their anthers and upper parts of the filaments forming a tube; or it may be said, the anthers combining, form a common cell for the pollen, which opens by a pore at its apex. On the lower margin of the pore are many short stiff hairs, which at first project across the pore closing it, but when the pollen is ripe they turn abruptly downwards and leave it open. There is only one pistil, which is armed near the end of the style with a collar of short stiff hairs, similar in size and character to those on the anthers just mentioned. The end of the style with its hairs forms the bottom of the pollen-cell before

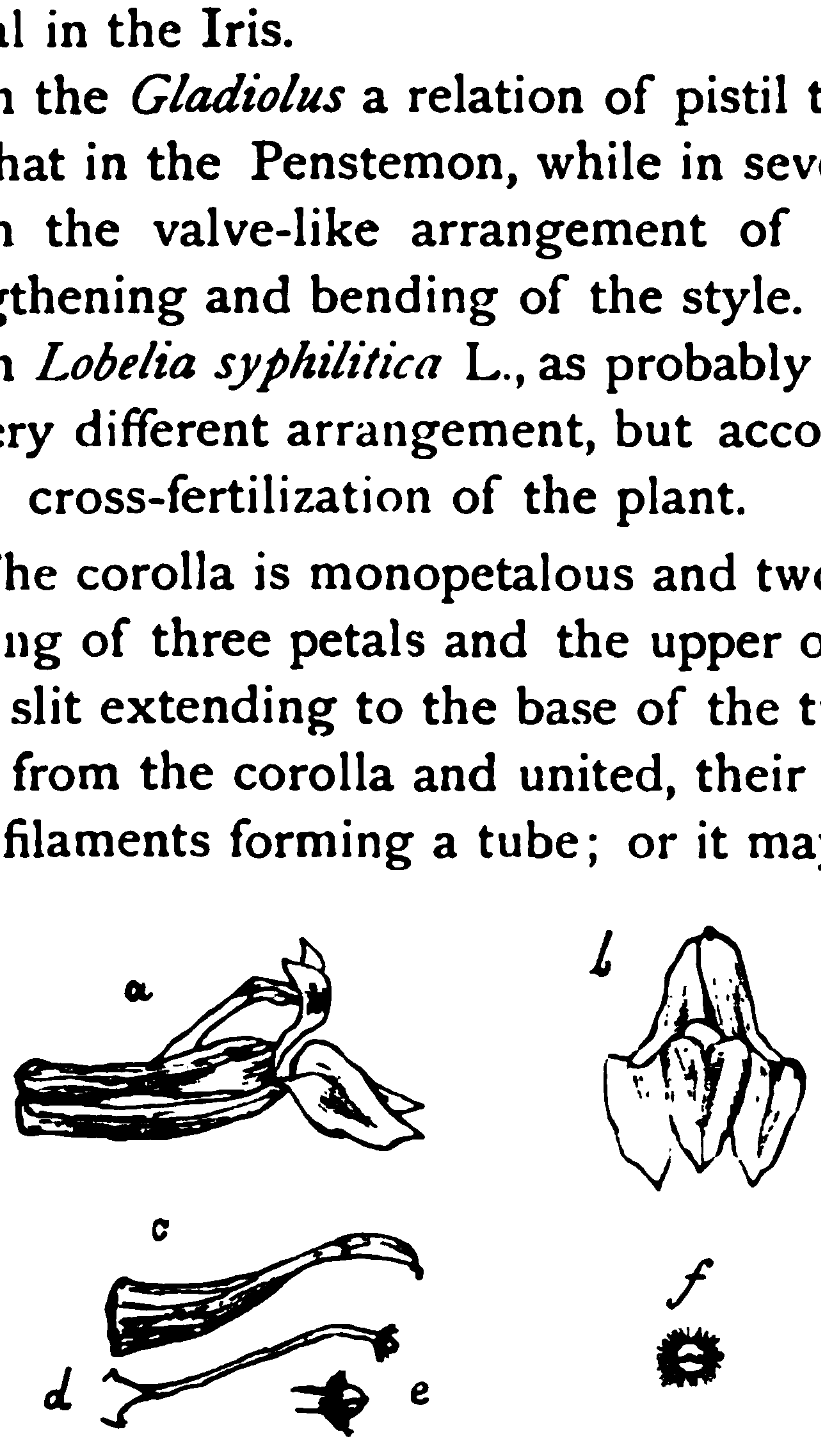

FIG. 7.—*Lobelia syphilitica* L., in the staminate stage.

a, side view, nat. size; *b*, front view, do.; *c*, stamens, do.; *d*, pistil, do.; *e*, stigma, enlarged; *f*, front view of do.; *g*, pollen cell; *h*, longitudinal section of do.

described. We have, therefore, the stigma shut up with the pollen in the same cell. "A capital arrangement for *self*-fertilization," one says. Nay, not too fast! The stigma is composed of two fleshy lobes, its receiving surface being on their inner surface. And they are closed firmly together, so that the end of the pistil looks like a closed mouth with its lips firmly pressed together. With its bristly collar it reminds one of Jack-in-a-box, with an unusually "stiff upper lip."

This combined pistil and stamens is S-shaped, and when the flower opens, it springs through the slit on the upper side of the corolla and stands with the tip of the pollen-cell just behind the upper lip of the corolla, vide Fig. 7 *a*. The front view of the same is given in Fig. 7 *b*. Sometimes there is no trace of the stamens seen from the front; but if an insect tries to enter, the slit between the petals opens, the hairs of the anthers strike his back, and as he forces his way in, they produce a jarring of the pollen-cell which freely sprinkles the pollen upon him.

As the pollen escapes it is kept up to the pore by the pressure caused by the gradual lengthening of the style. The hairy collar acting like a swab, sweeps the cell clean. When all the pollen is gone, the style, continuing its growth, pushes the stigma through the pore and forward through between the upper petals. The end of the style then comes downward, the lips of the stigma open and roll back as though turning inside out. This exposes the whole surface of the stigma to be covered with pollen from the back of the first insect which comes from a flower discharging pollen. So the cross-fertilization is beautifully accomplished.

FIG. 8.—*Lobelia syphilitica* in the pistillate stage. *a*, side view, nat. size; *b*, pistil and stamens; *c*, anthers and stigma, enlarged.

These entertaining structures present some very suggestive ideas. We are impressed with the importance of cross-fertilization in the economy of nature, but why it should be of any advantage who can tell? We readily see that in several of these cases cross-fertilization between flowers upon different roots is likely to be quite rare. In *Martynia* such fertilization may be quite frequent, as there are comparatively few flowers open at once, but

in *Gladiolus*, *Penstemon*, *Labiatæ*, etc., there are many flowers on the same root at the same time, presenting the various stages of advancement. The chances are strongly in favor, therefore, of their being fertilized by pollen from flowers on the same root. In the Iris, notwithstanding its elaborate structure to secure cross-fertilization, it is quite probable that a particular pistil will be fertilized by the pollen from a stigma of the *same* flower.

While, therefore, we may admit that these contrivances may be to render a little more frequent the transfer of pollen to ovules on different plants, yet it impresses the thought upon us that each flower (and in the Iris each *third* of what is commonly called a flower) is a distinct vegetable unit. Therefore separate plants, as they are commonly called, like their marine mimics, the Hydroids, would be colonies, composed of hundreds or even thousands of *phytons*.

One more lesson, which we find given in the following admirable words of Prof. Gray:

"Now, no matter whether or not the flowers themselves, with all these structures, have been perfected step by step, through no matter how long a series of natural stages—if these structures and their operations, which so strike the mind of the philosopher no less than of the common observer, that he cannot avoid calling them contrivances, do not argue intention, what stronger evidence of intention in nature can there anywhere possibly be? If they do, such evidences are countless, and almost every blossom brings distinct testimony to the existence and providence of a Designer and Ordainer, without whom, we may well believe, not merely a sparrow, not even a grain of pollen may fall."

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CURIOUS ABORIGINAL CUSTOMS.

BY W. J. HOFFMAN, M.D.

ONE of the most singular and wide-spread customs practiced by the aborigines of North America, was that of cutting off the nose of the woman found guilty of adultery. In a previous article in the NATURALIST,[1] several tribes were referred to as having practiced this mode of mutilation—one or two of them to within recent times. Since the publication of that paper, I have met with various references upon the same subject, which may be of sufficient interest to enumerate. The earliest notice of the

[1] Am. Naturalist, xii, 1878, pp. 560–562.

execution of this punishment dates back to the year 1660, when the Jesuit Fathers first penetrated the then extreme North-west. The informant says, in a letter to Father Claude Boucher,[1] that the Nadouechiouec (Dakotas) cut off the cartilaginous portion of the nose of an adulteress. John Payne,[2] in quoting Carver, states that, "Among this nation of Indians (Nawdowessies, *i. e.*, Dakotas), if a married woman is found to have been false to wedlock, the punishment inflicted upon her is for the husband to bite off her nose; this our author saw inflicted whilst he was in the country."

I had received information to this effect in 1872–73, while I was stationed on the Upper Missouri, but coming as it did from unreliable sources, I gave no credence to the stories of bygone punishments, as I had not seen any references to this practice among any tribes north of Arizona. Now, however, I am inclined to believe that there was some truth in the assertions above referred to. Several days ago, in conversation with several gentlemen upon aboriginal customs and manners, I chanced to mention this form of punishment, when one of them (a prominent official of the B. & O. R. R. Co.) remarked that he had seen squaws among the Utes, near Ft. Bridger, thus mutilated, and was told at the time, less than two years ago, that they had been punished for infidelity. No doubt others scattered over the extreme western portion of the continent practiced the same cruel custom at no remote time.

This extended throughout some of the tribes formerly inhabiting the country between the Mississippi and the Atlantic. Caleb Swan, writing about 1791, says,[3] that prostitution was common among the Creeks, and scarcely any attention was paid to it, as far as any punishment was concerned. But, when a marriage has been contracted according to the more ancient and serious custom of the tribe, it is considered more binding than ordinary, and in violation of this law, or in taking the least freedom with any other person, is considered adultery, "and invariably punished by the relations of the offended party, by whipping, and cutting off the hair and ears close to the head." In this case the ears are named only, but very probably the nose was included in

[1] Margry, Jesuit Rel. i, 1870, p. 53 *et seq.* [Extrait de la Relation de la Nouvelle-France, de 1660, addressee au Révérend Père Claude Boucher.]

[2] Universal Geography, iv., 1799, p. 42.

[3] Schoolcraft, v, 1868, p. 260.

some instances, as the latter was the organ chosen by tribes living near the border of the territory occupied by the Creeks. As before stated in the NATURALIST (Vol. xii, p. 561), Gregg[1] says of the Comanches that the "punishment is most usually to cut off the nose or ears, or both." The same author also says that the Creeks practiced the same custom[2] (having reference to the preceding).

Bancroft[3], in quoting Las Casas, says that in Itztepec (Mexico) "the guilty woman's husband cut off her ears and nose." The punishment among the Meztecs was sometimes commuted to mutilation of the ears, nose and lips.[4]

John Johnson,[5] referring to the Indian tribes inhabiting Ohio, says, "*Adultery* is punished by the family and tribe of the husband. They collect, consult and decree. If they determine to punish the offenders, they usually divide and proceed to apprehend them, one-half going to the house of the woman, and the other half to the family house of the man, or they go together, as they have decreed. They apprehend them, beat them severely with sticks, cut off their noses, and sometimes crop them, and cut off the hair of the woman which they carry home in triumph. If both parties escape, and those in pursuit return home and lay down their weapons, the crime is satisfied; if they apprehend but one of the offenders, and the other escape, they take satisfaction from the nearest of kin."

In this paper of Johnson's (who by the way was considered good authority) are enumerated the following tribes, viz: "Wyandots, Shawanoese, Senecas, Ottawas, Delawares, Miamies, Putawatimies and the Weas." It is questionable whether the Senecas, who were of the Six Nations, ever practiced this custom, as at no other time have I met with the names of any of the latter in this connection.

As before stated, the custom of cutting off both the ears and nose extended down into Central America, and César de Rochefort,[6] in speaking of the Caribs, refers to this custom as practiced

[1]Commerce of the Prairies, 1844, ii, 308, 309.

[2]Ibid, p. 308.

[3]Bancroft in Native Races, ii, 466, quotes Las Casas, Hist. Apologética, MS., cap. ccxiii.

[4]Ibid, p. 466. [Herrara, Hist. Gen., dec. iii, lib. iii, cap. xii.]

[5]Archæologia Americana, i, 1820, p. 285.

[6]Histoire des Antilles, 1681, p. 548. Quotes Lenscot, ch. 16, for Bengalese.

by the Bengalese, but makes no mention of it in reference to the Caribs. It would appear that some similarity existed, or he would not have been prompted to make reference to such an odd custom practiced near the opposite side of the globe. The Egyptians[1] cut off the nose of the guilty woman, and the man was beaten with rods; this is again, and very remarkably too, noticed in the punishment of the Nicaraguans.

The above references have been collated with the intention of illustrating the wide-spread prevalence of this singular and barbarous custom, and for the purpose of inducing the publication from others upon the same subject, for the purpose of ascertaining to what tribes and families the knowledge of it extended.

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NOTES ON A LOST RACE OF AMERICA.

BY LIEUT. A. W. VOGELES, U.S.A.

NO department of natural history appears at present to attract more general interest than that which relates to the prehistoric Aborigines of North America; nor is this to be wondered at, for throughout the extensive valley of the Mississippi, and also in the Gulf States, we find numerous mounds and remains of ancient fortifications; they have, however, been so ably described in the different scientific journals, that we shall confine the subject of this essay to those of Western Florida, which are not so generally known.

Of these ancient people no written history remains, nor can any reliable account be obtained from the Indians inhabiting the States, or from the earliest Spanish explorers. The Spaniards are silent upon the shell mounds of Florida, although they visited Tampa in 1512. We know only of the existence of these mounds, and of the arts, industries and manner of interment of the people who made them, and from these we can only add a link to the chain of evidence that connects the eastern mounds of Florida with those of the western coast.

The only group at Tampa, Fla., of importance to the archæologist, is a series of shell mounds running obliquely across the town, commencing on the southern seashore, on the military reservation of Fort Brooke, and extending to the Hillsboro

[1] Diodorus Siculus. Lib. i.

river. During the Florida war this series was complete, but at present it consists only of a large mound on the military reservation. The second, which was located immediately outside of the reservation, has been destroyed with the third mound situated near the site of the present town market. At the foot of the last mound in the clay banks of a small stream which flows into the river we find chippings of flint implements.

The only remaining representative of the ancient series of mounds is conical in form, being about fifteen feet in height, with a diameter at its base of about fifty feet. By digging into this mound, commencing at its apex, we found that its surface consisted of drifted sand, about five feet in depth; immediately beneath this we uncovered a layer of shells made up of the edible species of our southern coast, and generally composed of old valves of *Ostrea virginiana*, although among the shells there are a few fossil species which are common to our tertiary marls.

Immediately beneath the shells, in a white sand which forms the principal material of the mound, we uncovered a male skeleton, which was interred at an angle so that the head laid toward the east and south. It is remarkable that in the vicinity of the body we were unable to discover implements or ornaments. Continuing our excavations on the same level in a southerly direction, we found the remains of a second body, consisting of the pelvic bone of a female, and other parts with the exception of the skull.

It is worthy of remark that the sandy structure of this series of mounds corresponds with that of the sand dunes of our present sea coast which, in connection with the well-known geological fact of the former elevations and depressions of the Atlantic coast, would give a reasonable explanation for the phenomena observed in the study of the Tampa mounds. The recent elevation of the shore around Tampa is evident from the fact that immediately in the rear of the Fort Brooke mound we found a ridge parallel with the present southern shore line; it is composed of wave-broken shells, and probably formed the ancient shore line during the occupation of the mound, and has since been raised, although previous to its existence the whole shore line had a series of elevations and depressions, a fact which becomes self evident from an observation of the country directly in rear of the town of Tampa.

We would suggest the theory that these mounds were formed in the same way as our present sand hills along the Atlantic coast, and that in their sheltered position in Tampa bay, their form was preserved during the series of depressions of the coast by the shelly deposits made upon them by their inhabitants.

In digging into the sides of the Fort Brooke mound, we discovered the position of the original fire places, and in their ashes we found that the largest proportion of animal remains consisted of those of mankind. The longer bones, and especially the flattened tibiæ were charred and split; these were intermixed with those of the dog, deer and also burned oyster shells and portions of the common edible sea crab.

These incremations of human remains by the mound-builders, were evidently for the purpose of preparing food; at least we would so judge from the fact that the marrow bones are charred and split. We have then here the kitchen of a race of cannibals.

The pottery of the mound found near the former fire-places and also the implements, are very primitive; the latter consist of arrow heads, and in the former, which is generally plain in style, although now and then a few pieces of an ornamented pottery marked with chevron lines are found, the typical forms of the eastern mound group of Florida generally prevails.

The Cedar Key group of Florida is not contemporary with the shell mounds of Tampa, at least we would so judge after our investigations of that group with our friend Mr. Calkins, of Chicago. The pottery of the Cedar Key group is certainly much more ornamented than the former; this taken in connection with the number of implements found in these mounds by Mr. Calkins would certainly show a higher degree of advancement.

The habits, ceremonies and manner of interment of this lost race are parallel with those of the ancient Danes. These people constructed artificial hills for the sepulchre of their kings.[1] The cannibalistic habits are similar to those of the Troglodytes found in the caverns of Mount Chauvaux in the province of Namur, Belgium.

[1] Pascalis, an Exposition of the Danger of Interment in Cities, p. 12.

THE GEMMULE *VS.* THE PLASTIDULE AS THE ULTIMATE PHYSICAL UNIT OF LIVING MATTER.[1]

BY JOHN A. RYDER.

AS is well known to every well informed person, *protoplasm* is now regarded as the substance which enters universally and constantly into the composition of the living form-elements or cells of all living things. It is, therefore, the material basis of life. All the varieties of organic structure, no matter how different from each other, have been primarily differentiated from apparently homogeneous protoplasm. Premising, therefore, that we understand that all histological differences presented by the tissues of living organisms arise by differentiations of, or secretions, derivatives of *plastids* (cells) primitively alike, we are ready to consider the theories advanced to account for the phenomenon of hereditary transmission. *Transmission* or *heredity* may be defined as that inherent tendency acquired from ancestry and manifested by developing or growing organisms to become essentially like, in appearance and structure, their immediate ancestor or ancestors, if the parentage be a sexual one. The appearance of a characteristic belonging to a remote ancestor in a new organism, which characteristic did not belong to its immediate ancestor, is said to be a case of reversion or atavism. This is explained upon the assumption—a rational one—that in the germinal matter, that is, a plastid, or an egg-cell or a sperm-cell or cells, if reproduction be sexual, derived from the immediate ancestor, may still inhere a tendency to develop characteristics belonging to the most remote of, an indefinite number of removes back, from such immediate ancestor. The tendency to develop such palæontological characters is supposed to remain in a latent or potential state in all those generations intermediate between the ancestor in which this characteristic was present and the young organism in which it has again made its appearance. In this way gradually but continuously, and adaptively acquired characteristics are transmitted, as well as habits. It may be that profound and enduring sensory impressions upon the maternal organism in higher forms, by their persistence, may produce immediate effects upon the offspring which cannot be attributed to ancestry. The many

[1] Embracing the substance of an essay read before the Microscopical and Biological Section of the Academy of Natural Sciences, of Philadelphia.

recorded instances in the human family of the effect of the so-called pre-natal influences would justify such an inference.

The phenomena of development presented by the embryological history of an organism, are serially or successively related to series of ancestral forms in a way which shows that the most remote ancestor was indubitably unicellular, for all beings commence their embryonic history as a one-celled egg, or as an egg-cell fused with one or more unicellular spermatozoöids. To this law no exception has ever been discovered. It passes at first by a process, then by processes, as complication is established by the former; not by leaps, but from one stage to the next higher, and so on in an absolutely continuous manner, so that it is impossible to mark the transitions, so that absolute *continuity* becomes a fundamental characteristic of the process of development.

It has also been noted that these successive stages, or a part of them, often represent, perhaps always within the limits of groups, a sort of recapitulation or successive shadowing forth, sometimes faintly, sometimes strongly, of the forms which appear to represent the phases through which the organism has passed in attaining its present form and structure. The process of development accordingly shows in a pronounced, or may be dim way, the types which have successively formed the starting points of its development in past time. A *phylum* or branch from the tree of life or chain of ancestors, is thus represented in its embryonic history. The being, in its evolution from the ovum, accordingly recapitulates the forms of its successively more and more complex, or more and more modified ancestral series—its palæontological history preserved in the rocks together with more or less note of its living cotemporary allies. The fossil forms of successive formations are frequently found to bear such a relation to the developing embryo. The rock record linked with the now living one is said to be the *phylogenetic* history, that is, it unfolds the history of the *phyla*, or branches of the tree of life. The history of the being or ontological history, therefore, becomes a more or less distinct record of the phylogenetic. In a word, *Ontogeny*, or the development of individual beings, is an epitome of the *Phylogeny* or phylogenesis of the race to which they belong.

This doctrine and its modifications is the motive force of modern *Biology*. Upon this ground, *Laplace*, *Lamarck*, *Wolff*,

Von Baer, Darwin, Spencer and *Haeckel* have given to the science new impulses and aims far higher than possessed its masters in its infancy.

Dr. Darwin, in order to account for the phenomena briefly set forth in the above remarks, had recourse to what he called the "*Provisional Hypothesis of Pangenesis.*" The following is Mr. Galton's brief statement of the hypothesis:

1. Each of the myriad cells in every living body is, to a great extent, an independent organism.
2. Before the cell is developed, and in all stages of its development, it throws "gemmules" into the circulation, which live there and breed, each truly to its kind, by the process of self-division, and that consequently they swarm in the blood in large numbers of each variety, and circulate freely in it.
3. The sexual elements consist of organized groups of these gemmules.
4. The development of certain of the gemmules in the offspring depends upon their consecutive union through their natural affinities, each attaching itself to its predecessor in a natural order of growth.
5. That gemmules of innumerable varieties may be transmitted for an enormous number of generations without being developed into cells, but always ready to become developed, as shown by the almost insuperable tendency to feral reversion in domestic animals.

Galton, in order to test the truth of the foregoing hypothesis, transferred the blood of different breeds of rabbits from one to the other, actually establishing a cross-circulation, in which cases the blood flowing from one individual to another was practically unchanged. After this operation upon the animals, the young ones reared by these were not found to have been influenced in the slightest degree by the admixture of foreign blood with that already contained in the vessels of their parents, which should not have been the result were the hypothesis of *pangenesis* a true one. *Pangenesis* having been subjected to a crucial test and found wanting, nothing was offered, as an avowed substitute, until Haeckel proposed his *Provisional hypothesis of the Peregenesis of the Plastidule*, except by Prof. Cope, who, in his "Origin of Genera" (Proc. Acad. Nat. Sci., Phila., 1868), and afterwards in a paper entitled "On the Methods of Creation of Organic Types" (Proc. Am. Philos. Soc., 1871) more fully developed the views presented in the first mentioned. His views will be considered after Haeckel's have been discussed.

The *plastidule* of Haeckel is hypothetically the molecule of protoplasm, and therefore the simplest possible form in which protoplasm can exist as protoplasm. The theoretically high degree of complexity of the molecule of protoplasm renders it in the highest degree susceptible to influences brought to bear upon it by its environment. Primarily its atomic constitution C H O N, must be related in some way to its properties.

Haeckel attributes to every existing atom a modicum of force or energy as eternal and quantitatively unchangeable as the atom itself, which he calls the *atom-soul;* by aggregation of the atoms into chemical compounds, the mode and nature of the manifestation of individual atomic energies become mutually modified, and as resultants we have different properties and behavior manifested by such different compounds. By a long process of differentiation a compound was finally evolved answering in composition and properties approximately, or entirely, to existing protoplasm. This highly unstable matter, representing the aggregate or resultant of the energies of its component atoms as the energy of living matter, became the ancestor of some primordial amorphous being out of which, by adaptation and "survival of the fittest" the ancestors of the *Protista* became differentiated. On the principle that motion or impulses once imparted to bodies tend to be perpetuated in the absence of other interfering causes, the energy of movement, called life, once set going tended to be kept up, and in order that it could withstand the interference of a great variety af disturbing causes, it gradually acquired the power of adaptation. This adaptation being simply vibration of its molecules in unison with outer conditions as a resultant of those conditions. From the well known postulates in regard to the persistence of matter and motion, it is clear that the molecules of different masses, subjected to differing conditions, would gradually acquire different modes of molecular motion, which would tend to be persistent and perhaps approximately alike throughout the same mass. Any part of this mass broken off would tend to retain the molecular movements and consequently the properties of that of which it at first formed a part, but the new conditions to which it might become subject in the event of separation, render it probable that these motions might have others superadded, or the old ones so changed as to give rise to different phenomena. Different food, temperature, surrounding, media, etc., are thinkable

as immediately active causes in the differentiation of the modes of molecular activity. Accordingly by the persistence of the type of molecular motion or motion of the *plastidule*, its characteristics tend to be exactly reproduced where reproduction is a process of mere division, as in the *Protista*. On the other hand, the motion of plastidule tends to vary as the surrounding conditions vary. Hence the difference in individuals arising from this adaptive power of the plastidule to accommodate its motions to the environment. Where the process of reproduction is sexual the fusion or blending of the products of the sex-glands to form embryos, there results a blending of the plastidular motion of the two. The characteristics of the resulting being is hence a resultant of two molecular modes of motion in the same way as the diagonal of a parallelogram of forces is the resultant of two more or less antagonistic forces. Putting this and that together, it is clear in what manner the characteristics of the offspring of sexual unions may come to preponderate in favor of the one or the other parent as the plastidular-molecular motion of the germ elements preponderates over that of the sperm element, and *vice versa*, thus mutually modifying each other in order to produce a resultant. It is also conceivable that the plastidular motions of remote ancestors as well as of approximal ones, tending to be persistent, may suddenly re-appear under favorable conditions, and that in this way there may arise a tendency to revert to such ancient progenitor. This hypothesis, if extended so as to conceive of the molecular vibrations of different stages of development as composing parts of a great molecular rhythm coeval with the first appearance of life on the earth, also explains the phenomenon of the recapitulation of *Phylogeny* and *ontogeny*. The tendency is to manifest the molecular motions in the order in which they succeeded each other in time. The registry or repetition in ontogeny being not always exact, it may be assumed that in the process of differentiation some of the types of vibration were in these instances irrecoverably lost.

Stated thus briefly, it seems to me unnecessary to enter into the account of the hypothesis of *perigenesis* further than to impress upon the mind of the reader that the vibrations of the plastidules are adaptive in character, that is, they are the resultants of outward conditions, represented hypothetically by X or any other unknown static or dynamic quantity. The theory is therefore purely me-

chanical and causal, and hence the word *perigenesis*—generated by surroundings. It seems to me that some form of hypothesis similar to this will be adopted unless the current views in regard to the physical constitution of matter undergo very great changes. It may be, if reports be true, that the so called elements are not elementary, as Mr. Lockyer has been led to suspect from his spectroscopic researches, but even this will not destroy the essential elements of the problem, which are undoubtedly to be expressed in terms of matter and force without respect to what the nature of that matter may be.

Prof. Cope (l. c.) after discussing at length the evidence in favor of the correlation of life forces with the other physical forces and its conservation, goes on to particularize as follows: "Dr. Carpenter, in describing the correlation of physical and vital forces, defines the difference of organic species to be similar to that prevailing between different chemical bodies (the latter depending on different molecular and atomic constitution), which leads them 'to *behave* differently' from each other under similar circumstances. This may be more fully expressed by saying that different species possess different capacities for the *location* of the conversion of the physical forces into growth force." On this basis, "A 'descent with modifications' contemplated by evolution signifies a progressive change in this capacity." Applied to the explanation of his law of *Acceleration* and *Retardation*, he says: "*Acceleration* means an increase in this capacity; *retardation* a diminution of it." In other words, the undulations or vibrations of the molecules of different organisms and different parts of organisms differ in character, which is essentially the doctrine of Haeckel. He also speaks of growth force [energy] as cumulatively *potential* (p. 26). Its degree of potentiality he considers as marking the degree or grade of *grade influence* as manifested by successive higher forms. Grade influence is supposed to be the resultant of "effort and use" in the process, so that the static or dynamic environment and the organism are considered to be in a relation of retroactivity—in a state of interaction. At page 29, "Method of Creation," *On the transmission of Grade Influence*, the author admits: "How force potential in nerve structure is inherited through the reproductive elements is a great mystery," but he observes further: "In the spermatozoöids * * * growth force [energy] remains potential," that is, in a static condition,

ready to be set free in the dynamic process of fertilization of the ovum, and of embryonic development. "Growth force potential in the spermatozoid, on its destruction [fusion with the egg] becomes converted into heat or other force. Thus may originate the growth force of the ovum, which, once commenced, is continued through the period of growth." It seems to me probable that the process of repetition is simply a phase of the manifestation of growth force as in the asexual fusion of growing cells, formation of spores in low plants and navicellæ cysts in *Gregarinæ*. It seems to me probable, also, that the cleavage of the yelk of the ovum supervenes just as soon as the static condition of its molecules is interfered with by blending with the spermatozoöid whose molecules are in a dynamical or potential condition as aforesaid. It is clear that if this is true, we get a composite result or resultant. In point of fact, this is tacitly implied where Prof. Cope says in continuation: "The process might be compared to the application of fire to a piece of wood. The force conversion is communicated to other material than that first inflamed." That is, the molecular movements of the embryonic mass, viz., sperm and germ, tends to be assumed by all the material which it appropriates to itself; this may be extended to the process of digestion or appropriation of protoplasm in animals and to the formation of protoplasm by plants when in growing conditions from binary and ternary compounds It is also clear that the quantitatively indefinite element x of the modifying environment of the plastidule is admittedly involved in consideration of the effect of *use and effort*, as held by this distinguished biologist, and that if use and effort are modifying causes, and molecular vibrations, whether they be in waves or ellipses or curves of any kind, will be influenced and accordingly modified. It must also necessarily be implied that these effects are persistent and that they involve the idea of *Perigenesis* quite as much as the plastidule.

The totality of the phenomena of *differentiation* and *reduction* (*specialization*, *cephalization*) in living forms, are, in view of the foregoing considerations, it seems to me, to be referred to dynamical causes. Laplace, from a mathematical standpoint, saw that this must be so. Lamarck, in his *Philosophie Zoologique*,[1] in the chapter VII, tom I, pp. 218–268, entitled, "*The influence of circumstances upon the actions of animals*," has some observations

[1] Nouvelle Edition, tom. I and II, Baillere, Paris, 1830.

which show what a profound conception he possessed of the causal relations existing between the uses of parts and their development. Of recent authors, Darwin must occupy the first place, as many of his hosts of facts are admitted by him to bear a more or less distinctly dynamico-causal interpretation (*vide*, *Variation of Animals and Plants under Domestication*). By far the most comprehensive principles of dynamical biology have, however, been suggested by Herbert Spencer,[1] and they must be regarded as the first attempts at scientific presentation of the subject, in which, although the factors of the problem were not stated quantitatively in most instances, yet enough was said to show the applicability of the quantitative method. Besides these authors, more recent writers have begun to pay attention to the subject. Prof. Owen has for many years avowed his leaning to Lamarckianism. Prof. Jäger,[2] of Stuttgart, has written upon the influence of mechanical strains in determining the length, etc., of bones. Prof. Lucae, of Frankfort, a. M., has also contributed to this subject. Gegenbaur, in his "*Elements of Comparative Anatomy*," has numerous observations upon this subject. Prof. Cope may be added to this list, having contributed an article bearing solely upon this subject, to this journal, within the past year. This author, who, as we have seen, had already advanced views similar to Haeckel's, which, if not as clearly expressed, were nevertheless published more than five years previously. These names show that I have not been alone in the study of animal metamorphosis as produced by means of dynamical agencies. I have always held that both the organism by means of its voluntary acts and its passive surroundings reacted upon each other so as to produce morphological and consequently structural changes. My short essay, "On the Laws of Digital Reduction," which appeared in this Journal (Oct., 1877), and which was republished in the *Kosmos*, for 1878, illustrates what I have just said. My papers on the "Mechanical Genesis of Tooth-forms"[3] also show the application of the method, besides minor papers on the mechanical differentiation of certain portions of the vertebral column, in this Journal and Popular Science Monthly, 1877.

The logical consequences of the acceptance of the Hypothesis

[1] *Principles of Biology* and also his *Principles of Psychology*.

[2] *Jenaische Zeitschrift*, Bd. V., 1869.

[3] *Proc. Phila. Acad. Nat. Sciences*, 1877, and the *Dental Cosmos*, 1878 (Etiological Addenda).

of the Perigenesis of the plastidule, and with it the theory of dynamical differentiation—because the latter is no longer a hypothesis—forever relegates teleological doctrines to the category of extinct ideas. No matter how much our ideas may need to undergo modification, some similar hypothesis must eventually hold sway over the minds of biological thinkers, as the facts of science point in that direction and in no other.

It has been suggested in conversation by my friend Dr. A. J. Parker, of this city, that the assumption of the *plastidule* as the ultimate physical unit of living matter was unnecessary, as it consisted merely in naming the protoplasm molecule, and it must be admitted that this view of the case is not without reason. Prof. Haeckel, it is to be supposed, however, adopted this name merely to distinguish his own provisional hypothesis from that of his acknowledged master. The word *plastidule* is a diminutive of the current word *plastid*, which is synonymous with cell, and therefor, implies and correctly, too, that the *plastids* are aggregates of varying numbers of plastidules, which are for physical reasons the smallest possible or conceivable units of living matter, of which even the most minute *gemmæ* or budding cells are composed.

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ABSORPTION OF WATER BY THE LEAVES OF PLANTS.

BY ALFRED W. BENNETT, M.A., B.S., F.L.S.

ALTHOUGH gardeners universally maintain that growing plants have the power of absorbing water through their leaves, both in the liquid and the gaseous form, in addition to the power of suction through the root, yet the contrary theory has been in favor during recent years among vegetable physiologists. The first recorded experiment, of any value on the subject, was about the year 1731 by Hales, as described in his "Vegetable Statistics;" the conclusion to which he came being that "it is very probable that rain and dew are imbibed by vegetables, especially in dry seasons." This result was confirmed by Bonnet in 1733. A century later, however, in 1857, Duchartre, experimenting on the absorptive power of plants, came, after considerable wavering, to the conclusion that rain and dew are not absorbed by the leaves of plants. This opinion has been, with but little exception, held by all physiologists during the last twenty years, notably by

DeCandolle and Sachs; the explanation offered of the fact that withered plants revive when placed in moist air or when the leaves are moistened, being that transpiration is thus stopped, or is more than counterbalanced by the root-absorption. In his "Text-book of Botany" (English edition, p. 613) Sachs says: "When land plants wither on a hot day and revive again in the evening, this is the result of diminished transpiration with the decrease of temperature and increase of the moisture in the air in the evening, the activity of the roots continuing; not of any absorption of aqueous vapor or dew through the leaves. Rain again revives withered plants, not by penetrating the leaves, but by moistening them and thus hindering further transpiration, and conveying water to the roots, which they then conduct to the leaves." McNab has, however, proved that leaves do transpire, even in a moist atmosphere, provided they are exposed to the action of light. The result of recent experiments, conducted by Boussingault in France, and by the Rev. George Henslow, in England, seem to force us to return to the earlier theory held before the time of Duchartre.

Boussingault's experiments relate not only to the absorption of water by leaves, but also to transpiration under various atmospheric conditions. The first experiments were as to the amount of transpiration from the Jerusalem artichoke in sunshine, in shade and by night. This he found to be hourly, for every square metre of foliage, sixty-five grammes in sunshine, eight grammes in the shade, and three grammes during the night. In the vine the corresponding numbers were thirty-five grammes in sunshine, eleven grammes in shade, 0.5 grammes by night. He reckoned that an acre of beet could give off, in the course of twenty-four hours, the enormous amount of between 8000 and 9000 kilogrammes of water, and a chestnut tree, thirty-five years old, sixty litres of water in the same time. The next question investigated was whether the absorption of water by plants, and the ascent of the sap, are due to the force resulting from transpiration on the surface of the leaves, or whether the roots exercise also a certain amount of force to this end. In the case of mint, a plant with roots, showed an hourly evaporation per square metre of eighty-two grammes in the sunshine, and thirty-six grammes in the shade; without roots the evaporation was sixteen grammes in sunshine, fifteen grammes in shade. The effects

of pressure on the absorption were next examined. A chestnut branch dipped in water was found to transpire hourly sixteen grammes per square metre; when inserted into a tube of water and subjected to the pressure of a column of water two and a-half metres high, the evaporation amounted to fifty-five grammes per square metre per hour, and the branch, at the end of five hours, weighed more than at the commencement. As to the effect of the epidermis in restraining evaporation, he found that an apple deprived of its skin loses fifty-five times as much water in the same time as one with its skin entire; while similar experiments in the case of a cactus leaf showed a difference in the proportion of fifteen to one. Losses by rapid evaporation lessen appreciably the physiological energy of leaves. Thus an oleander leaf containing sixty per cent. of water, when introduced into an atmosphere containing carbonic acid gas, decomposed sixteen c. cm. of the gas; one containing thirty-six per cent. of water decomposed eleven c. cm.; while one containing twenty-nine per cent. of water was without action. As respects the relative power of evaporation possessed by the upper and under surfaces of leaves, he found the average proportien in a dozen different kinds to be as one in the former to 4.3 in the latter case.

Boussingault then proceeded to investigate the question of the ability of leaves to replace the roots of a plant in serving as the agent of absorption. A forked branch of lilac was so placed that one portion was immersed in water in a reversed position, while the other was exposed to the atmosphere, the superficies of foliage in both portions being the same. The transpiration from the exposed portion was found to be the same as under normal circumstances, and after the lapse of two weeks the foliage was as fresh as at the commencement, showing that the submerged leaves were fully able to replace the roots in supplying the shoot with moisture. A vine-shoot half plunged in water maintained a normal evaporation in the free foliage, and remained fresh for over a month. An oleander shoot, under similar circumstances maintained its normal appearance for four months. With the artichoke it was found necessary that the amount of surface of leaves beneath the water should be four times that above it. A number of experiments, with regard to the power of leaves to absorb water in the state of vapor from a saturated atmosphere, showed that they could do this only when they had previously lost a por-

tion of their water of constitution, *i. e.*, that which is essential to their normal existence. Thus a wilted branch of periwinkle, weighing four grammes, after remaining for a day and a-half in an atmosphere saturated with aqueous vapor, weighed 4.2 grammes; after twelve hours immersion in water it weighed 9.4 grammes. His last experiments related to the power of leaves to absorb aqueous solutions. Drops of water containing 0.2 per cent. of calcium sulphate in solution were placed on the leaves of a great variety of plants under conditions favoring absorption, and protected from evaporation by inverted watch glasses with greased edges. In most instances the drops were entirely absorbed, leaving no trace of the mineral matter. As in the case of pure water, the under surface of the leaf absorbed much more rapidly than the upper surface. Solutions of potassium sulphate and nitrate gave corresponding results; the absorption of solutions of sodium chloride and ammonium nitrate were not so perfect. It is obvious that these results must considerably modify the view at present held by physiological botanists, that the small quantity of ammonium carbonate contained in the air, which is believed to be the sole source of the nitrogen in the tissues and secretions of plants, can only be absorbed by the roots after having been brought down to the soil by rain.

Mr. Henslow's experiments, as detailed in a paper read at a recent meeting of the Linnæan Society of London, are altogether in harmony with those of the French professor. The results of a very large number of experiments extending over several years, may be epitomized as follows:

1. *The absorption of water by internodes.*—The experiment consisted of wrapping up one or more internodes of herbaceous plants in saturated blotting-paper, and in noting the effects. As a rule the leaves on the shoots rapidly perished, showing that transpiration was too great for the supply. The stems, however, kept fresh for different periods up to six weeks.

2. *Absorption by leaves to see how far they could balance transpiration in others on the same shoot.*—The general result is that as long as the leaves remain green and fresh in or on water, they act as absorbents; but that the leaves in air keep fresh or wither according as the supply equals or falls short of the demand.

3. *To test how far leaves on a shoot can nourish lower ones on the same.*—It appears that it is quite immaterial to plants whether they be supplied with water from the absorbing leaves being above or below those transpiring. Water flows in either direction equally well.

4. *Leaves floating on water.*—It was found that one part of a leaf can nourish another part for various periods, though the edges out of water died first.

5. *Absorption of dew.*—A long series of cut leaves and shoots were gathered at 4 P. M., then exposed to sun and wind for three hours, then carefully weighed and exposed all night to dew. At 7.30 A. M., after having been dried, they were weighed again, and all had gained weight, and quite recovered their freshness, proving that slightly wetted detached portions do absorb dew.

6. *Imitation dew.*—Like results followed from using the "spray," by which dew could be exactly imitated.

7. *Plants growing in pots*, and of which the earth was not watered, were kept alive by the ends of one or more shoots being placed in water; *e.g.*, *Mimulus moschatus* not only grew vigorously and developed auxiliary buds into shoots, but also blossomed.

By these interesting experiments the physiological botanist is again placed in harmony with the gardener who syringes his plants not merely for the purpose of washing off dust and insects, but in order to facilitate the actual absorption of water by the surface; and with the field botanist who sprinkles the plants in his vasculum with water to keep them fresh till he reaches home. Mr. Henslow concludes with the following hints as to preparing bouquets of cut flowers:

If some plants have buds upon them, let the stalks long, and allow a few leaves to remain on and be also immersed in the water, and the buds will then be often found to expand successively. The cut end, to be more absorbent than it otherwise would be, should be again cut off under water. If the blossoms be on a ligneous stem, as of lilac, then the loss of water by evaporation is greater than the woody stalk can supply, so that in this case the addition of leaves in the water will greatly aid, and retain the bunch of flowers fresh for a longer time. On the other hand, if a blossom be already about to shed its petals, then the additional supply of water furnished by the leaves on the stalk appears to hasten the coming dissolution, and the flower perishes rather sooner than it would otherwise do. The water must be changed every day, and the submerged leaves must be lightly wiped with a cloth, as by endosmotic action they soon become more or less coated with mucus. No leaves must be in water unless perfectly green and of vigorous growth.

THE BREEDING HABITS OF THE EEL.

BY A. S. PACKARD, JR.

THERE is a considerable degree of mystery regarding the spawning time of the common eel (*Anguilla bostoniensis*), the place of spawning, and especially the differences between the male and female. The following facts appear to throw some light on the subject, and are published with the hope that it may stimulate others to observe with care and in detail all the facts regarding the spawning habits of a fish which is interesting as being the lowest bony fish, and is more and more used as an article of food, several eel-fishing establishments having been lately started in this country.

So far as we are aware, the eggs of the American eel were first discovered by Mr. John Mooney, of Providence, R. I., in October, 1877. Mr. Mooney is an intelligent mechanic and a close observer, but entirely self-taught. He carried the eggs to Prof. John Pierce, of Providence, who assures me they were veritable eggs, and measured one-hundredth of an inch in diameter.

Late in December, 1877, Mr. Vinal Edwards sent eight eels to the Museum at Cambridge. These were examined by Mr. F. W. Putnam, who reported upon them to the Boston Society of Natural History.[1] He states that during the month of December eels were brought into New Bedford "with eggs in various stages of development; where they spawn is not yet known." The specimens examined by Mr. Putnam "had the ovaries in various stages of development. In two the ovaries were very small, and the eggs in them exceedingly minute. From these the series showed a gradual increase in the size of the ovaries and the contained eggs, to the specimen exhibited, in which the eggs were still so small as only to be seen by a lens of considerable magnifying power, and not yet ready to be excluded, though the ovaries themselves were large and full."

During the month of November, 1878, I found several eels in spawn in the Providence market, and at my request, Mr. Mooney brought me two eels, one of which he pronounced to be a female and the other a male. The ovaries of the female were larger and fuller than in any other female I have examined, and the eggs riper. The eggs of this eel, which was about two feet in length judging by the portion secured from the fisherman by Mr.

[1] Proceedings of the Boston Society of Natural History, 1878, Vol. 19, p. 279.

Mooney, were distinguishable by the naked eye, were well filled with yolk cells, with a clear nucleus, and measured nearly two millimetres (1.90 inch) in diameter. The under side of the eel was tinged with golden-yellow. Mr. Mooney's so-called male was darker, dull silvery beneath. A microscopic examination showed that the thin sexual gland was quite different in histological structure from that of the ovary, and the examination of several undoubted male eels, with active spermatozoa, showed that Mr. Mooney was right in his conjecture that his supposed male was really such.

Fourteen eels were then obtained, from twelve to about sixteen inches in length, and ten of them were examined with a Tolles fifth and Hartnack immersion, No. 10. Several females were examined, and it was found that it was easy with the microscope to determine the sexes, from the different nature of the histological structure of the reproductive glands. The results of our examination are as follows: The males are abundant, and it seems probable that there is an equality in the number of individuals of the sexes. When about a foot in length, namely, when the eels are about a year old, there are no external structural differences, but at this period the males contain sperm cysts, sperm cells and immature (?) spermatozoa.

When the eels are from eighteen inches to two feet in length, in the autumn and early winter, the external sexual characters appear. This is confined to the style of coloration. No external structural characters could be detected, the form of the head, lips, body, fins and even the single genital pore being identical in the two sexes. In color the females are of a rich yellow on the under side, especially the long anal fin; the median line is silvery, but on each side there is a pale yellowish line. In the males the yellowish tint is entirely wanting, except on the long anal fin, the belly is dull silvery, and pigment spots are numerous beneath the head.

It is probable that the females are larger than the males, and when the ovaries are filled with ripe eggs, the body is a little more swollen than in the males.

The testis, as well as the ovary, is in the eel attached by one edge to each side of the intestine, and hangs vertically down in the body cavity. There is no oviduct, but the eggs or spermatic particles, as the case may be, drop directly by dehis-

cence into the body cavity, and pass out through a funnel-shaped fold of the peritoneum by a single small pore or opening identical in form and situation (just behind the anus) in each sex. There are not two openings, as has been stated by some authors. The testis does not differ in form and appearance from the ovary when the female is not in spawn, at least we could find no differences except that it is rather thinner. Both the right testis and ovary extend, in individuals about seventeen inches long, from about an inch and a quarter behind the vent, to near the diaphragm; extending on the right side to half way between the anterior end of the gall bladder and the diaphragm, while both the left testis and ovary are shorter than the right, ending an inch behind the diaphragm.

Microscopically examined the ovarian eggs lie in rows, with the stroma or tissue of fat cells between them. In the testis the spermatozoa are developed in sperm cysts, or "mother cells," much smaller than the ovarian egg (one-sixth to one-fifth mm). The mother cells contain a nucleus about one-third the diameter of the mother cell; in the nucleus is a dusky nucleolus about one-half the diameter of the nucleus. The sperm-cells are developed in the nucleus. They are nucleated, the nucleus large, and they (the sperm-cells) vary from $\frac{1}{10000}$ to $\frac{1}{3000}$ inch in diameter. The spermatozoa themselves are very minute, from $\frac{1}{50000}$ to $\frac{1}{90000}$ inch in diameter. They are active in their movements, the tail was indistinctly seen, but is present. It is doubtful in my mind whether a male eel when less than eighteen or twenty inches long, *i. e.*, when in its first year, is capable of fertilizing the eggs, as most of the spermatozoa noticed seemed not fully developed. In males twelve to fifteen inches long, *i. e.*, about one year old, the number of spermatozoa was much less than in larger, older individuals.

From information collected from persons living in Providence, it appears that the eels begin to descend the rivers and brooks of Rhode Island and Connecticut at the first frosts, when fishermen begin to catch them in eel-pots. They are in spawn in October, November and December, and probably through the winter, and they probably spawn in shallow salt and brackish water in harbors and at the mouth of estuaries and rivers, where it is well-known eels are speared in winter. That eels spawn in the autumn and early winter, and that the young soon hatch, seems proved by the fact that young eels from two to three inches long appear

in the spring, in April and May. I caught an eel at Providence, six inches long in October. It seems probable from this fact and the statements of others,[1] that by the last of summer and early part of autumn the eel hatched in late autumn or the winter attains a length of from six inches to a foot in length, and becomes from sixteen to twenty-four inches long the second year. It is well-known to all who have raised fish, or studied the embryology of animals, that individuals of the same brood may be accelerated or retarded in growth, so that eels a year old may vary greatly in size.[2]

In conclusion, so far as our observations extend, our common American eel descends fresh water streams into the salt water of harbors and estuaries, while those habitually living in the sea spawn at the mouths of rivers and in shallow harbors in the autumn and early winter, if not through the winter; the sexes only differ in color and in the histological structure of the reproductive glands, and do not breed until at least the second year. The eggs and spermatozoa are exceedingly minute, the former must be laid by millions; the young are two or three inches long in the middle or last of the spring, and the eel grows about an inch a month until maturity. It is desirable that these facts and inductions should be proved or disproved, and that the entire history of the breeding habits of the eel, hitherto so obscure, should be cleared up.

Since the preceding lines were written I have read Dr. Syrski's "lecture on the organs of reproduction and the fecundation of fishes and especially of eels" (1874), translated in the Report of the U. S. Commissioner of Fish and Fisheries for 1873–4 and 1874–5. The author gives an interesting review of the various and discordant opinions as to the breeding habits of the European

[1] Last June Mr. D. G. Colwell procured several thousand young eels and placed them in the mill pond. They were about two inches long at that time. Last Saturday, while working in the mill race, he caught one which was over seven inches in length, showing that they had grown about one inch per month since placed in the pond. In about a year from now we may expect good eel fishing in the Shiawassee.—*Quoted from Fenton Independent, Michigan, in Forest and Stream, Nov., 1878.*

[2] For example, the small eel above referred to, about six inches in length, collected early in October, had not increased in size two months later; it has not been fed since its capture. As regards the food of eels, Mr. S. A. Simmons, Jr., of Providence, informs me that eels sometimes feed on the eggs of the king crab (Limulus), burrowing under the latter when spawning.

eel. It appears that Carlo Mundini first discovered the ovary of the eel in May, 1777; this was confirmed by Rathke, who described the eggs. Siebold (1863) states that eels may reproduce by parthenogenesis, or are hermaphrodite. In 1872 Ercolani claims to have found spermatozoa in eels, but Syrski is positive that he mistook them for "the molecular movement of the granules found so frequently in the tissues of the animal body." Whether Ercolani was right we have not at present the means of ascertaining, but think it more probable he was right than his critic, Syrski. In the same year (1872), Crivelli and Maggi, of Pavia, claim to have discovered, and have figured the spermatozoa. This memoir we have not yet seen. Syrski does not seem to endorse their statements. In 1874 Prof. Münter stated that he found ovaries in about 3000 eels examined for that purpose, but he never found a male eel, *i. e.*, a milter. He therefore admits that eels are reproduced by parthenogenesis, *i. e.*, from non-fecundated eggs, and remarks, "In all probability the eggs are deposited at the bottom of the Baltic sea from the middle of March to the middle of April, and the young eels, one-half to two inches long, born from such eggs, migrate into fresh water about the beginning of May."

Syrski then describes and figures the ovaries and "testes," as he regards them, of the eel. The "eggs" figured as such by him are certainly not such, but are the male sperm-cysts, and he has thus entirely mistaken the sex of the eel. He does not figure or describe the true ovarian egg or the ripe egg, which are, in the American eel at least, wholly different in their mode of development from Syrski's so-called eggs, and so different that we doubt not but that his females were really the males of the European species. He figures and describes a portion of what he regards as a testis, but gives no description of the mother-cells, sperm-cysts and spermatozoa; of the latter he says nothing. It is evident that this observer has been throughout mistaken, and has thrown little light on the subject.

To be sure that I have not been over confident in regard to this matter, after reading Syrski's article I have dissected another living male, and found the mother-cells, sperm-cysts and the exceedingly minute, free-moving spermatozoa, which were more abundant than usual in small males. I also reëxamined the ovary of a female not in spawn, and demonstrated them to Mr. J. S. Kings-

ley, who adopted the view that the bodies he saw could not have been anything else than spermatozoa. My friend, Prof. John Pierce, an experienced microscopist, several times with me examined the free moving spermatozoa (we saw hundreds in active motion), and agrees with me that the bodies we repeatedly observed from different males could not have been organic particles vibrating through the Brownian motion. We both, without distinctly observing the tails, witnessed effects that must have resulted from a rapidly vibrating appendage or "tail."

NOTE.—Since the above was written I have received (Dec. 12) from Mr. Vinal N. Edwards, of the U. S. Fish Commission, a number of eels from Wood's Holl, Mass., forwarded at the suggestion of Prof. Baird. There were two races or varieties among them, some dark with yellow on the belly, others light and silvery beneath, with the anal fin bright red, as well as the edges of the pectoral fins. I supposed that the yellow bellied ones were females and the silver bellied ones were males, but found males and females of both races; so that while the above remarks concerning the colors of the sexes may apply to what eels I examined from Providence River, in the Wood's Holl specimens, there was absolutely no colorational difference between the sexes, and the difference in color is probably due to the color of the water, and especially the nature of the sea bottom, whether sandy or muddy. The females from Wood's Holl were about ready to spawn, and the males contained more abundant spermatozoa than any others examined, but no milt.

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RECENT LITERATURE.

SARS' MOLLUSCAN FAUNA OF ARCTIC NORWAY.[1]—The connection between the northern faunæ of East America and Europe is so close that monographic work of any kind done for one region, deserves and usually obtains the careful attention of students whose field of research is in the other; and it is daily becoming more necessary as wider observation reveals with greater clearness the intimate relations which the two districts bear to one another. This is especially true of the marine animals, and therefore the appearance of Prof. Sars' important work on the Mollusca of Arctic Norway is an event of no little interest for the American student of northern invertebrates. The well known ability of the author as an observer, an investigator and an artistic delineator of the objects he describes, warrant us in expecting results, in the main, of the highest excellence. Yet candor compels us to admit that these expectations are only partly fulfilled.

The work contains a short introduction followed by a description of each species in zoölogical order, without synonymy or des-

[1] *Bidrag til kundskaben om Norges arktiske Fauna, I, Mollusca Regionis Arcticæ Norvegiæ.* Af Dr. G. O. SARS, Prof. Zoöl. v. Christiania Univ. Universitets program for förste halvaar 1878. Christiania, 1878. 8vo, pp. 466. Map and fifty-two autographic plates.

criptions of the genera, and with occasional but incomplete references to specific synonyms, followed by such remarks on each species as the wide experience gained by the author from eighteen years of study has suggested. The length of time over which the work has extended, has rendered a short supplement necessary to the main body of the book, which is followed by tables of geographical distribution and a discussion of the questions involved in this branch of the work, a full index, and the plates with their explanation. The text is in Norwegian and the descriptions of families and species in Latin.

The plates are autotypic and contain an amount of work which must be seen to be appreciated. It is true that a certain amount of progress may be traced in them, a few of the earlier ones being slightly less artistic than the rest, and an occasional correction will suggest itself to the special student, but aside from these inconsiderable matters, it may well be doubted if the animals of any other fauna have ever been so thoroughly and effectively treated by the pencil of a competent draughtsman. They are simply invaluable to the student of Arctic and boreal Mollusca, not only for their delineation of species (often unfigured elsewhere), but for the thoroughness with which accessories, too often neglected, such as dentition, opercula, anatomical details, etc., are represented whenever known. These plates alone would form for the author an enduring claim to the gratitude of his fellow naturalists of all countries.

A serious drawback, however, to the fullest usefulness of the work exists in its nomenclature, which does not appear to conform to any particular principles, and which most unfortunately adds very largely to the already overwhelming mass of synonymy with which this branch of science is loaded. Prof. Sars exhibits a tendency to divide species and genera to their fullest extent, and while this alone is not particularly reprehensible if carefully done, yet when done without great care, as in the present case, one may be pardoned for taking exception to the method, and lamenting the inevitable results. Thus we have as absolute synonyms of already established names, *Boreochiton* Sars (*Trachydermon* Crp.), *Boreofusus* Sars (*Troschelia* Mörch), and *Solenopus* M. Sars (*Neomenia* Tullb.) first described by Tullberg. *Craspedochilus* Sars, also belongs in a section first characterized and named by Carpenter. In this connection it may be mentioned that a reëxamination of the dentition of the Chitons would probably result in a revision of some of the figures. Of names which have been adopted without that search into their credentials which would have shown them to be untenable, a few may be mentioned. Such are *Portlandia* Mörch, *Tridonta* Schumacher, *Nicania* Leach, *Timoclea* Römer, *Rupicola* (?), *Antalis* Aldrovandus (?), *Delphinoidea* Brown, *Pilidium* Midd., *Pyrene* Bolten, and *Conulus* Nardo. Of names applied erroneously to forms which cannot by any

recognized rules come under them, there are quite a number, such as *Chiton* (restricted) for *Chiton hanleyi*; *Lepidopleurus* to *Chiton alveolus* M. Sars, *Nacella* to *Patina pellucida*, *Acmæa* (restricted) to *Collisella testudinalis*, while *Tectura* is retained for *Acmæa virginea*, *Scutellina* to *Pilidium fulvum*, *Ampullina* to *Bulbus Smithii*, *Chrysodomus* (as of Swainson) to *Fusus Turtoni*, while a typical *Chrysodomus* is called *Neptunea*, and so on. We are far from asserting that these blemishes are sufficient to condemn wholly a work which will always be of permanent value, yet it is impossible not to regret, that while the greater part of it is so very good the remainder was not brought a little nearer perfection. We presume the work, though not provided with a nominal publisher may be had of the author, or of the authorities of the University of Christiania. It was actually issued on the 6th of June, 1878, though proofs of part of the plates had been kindly furnished to several naturalists some time before their publication. —*W. H. Dall.*

SMITHSONIAN REPORT FOR 1877.[1]—This report, the last made by the lamented Henry, contains matter of very general interest, not only as to the workings of the Smithsonian Institution but also the progress in the scientific explorations of the United States. Of particular value is the full "List of the more important Explorations and Expeditions, the collections of which have constituted the principal sources of supply to the National Museum, with indication of the department of the Government under which prosecuted." Besides the numerous articles in the appendix, translated and original, concerning archæology, physics and meteorology, zoölogists will be interested in the translation of Weismann's interesting paper "On the Change of the Mexican Axolotl to an Amblystoma."

PALÆONTOLOGICAL REPORT OF THE PRINCETON SCIENTIFIC EXPEDITION OF 1877.[2]—This stout pamphlet represents the work of an expedition of students of Princeton College, who, under the auspices of Prof. Guyot, director of the museum of that institution, made an exploration of the fossiliferous beds of the Bridger Basin of Wyoming, and the fish-bearing shales of the South Park of Colorado. It is cause of congratulation on the part of the friends of scientific education, that the liberal endowment of this department at Princeton College should have commenced thus early to bear fruit, and in so profitable a direction. The seed sown by the late Mr. Green has evidently fallen into good ground, and we see at once the realization of President McCosh's view, that the great schools should not only be institutions for teaching,

[1] *Annual Report of the Board of Regents of the Smithsonian Institution . . . for 1877.* Washington, 1878. 8vo, pp. 500.

[2] *Contributions from the Museum of Geology and Archæology of Princeton College.* No 1, Palæontological Report, etc. By HENRY F. OSBORNE, WM. B. SCOTT and FRANCIS SPIER, Jr. Sept. 1, 1878. 8vo, pp. 146, pl. x.

but also furnish the facilities for the prosecution of original research.

The present report gives descriptions of the osteology and dentition of species of most of the leading forms of the Bridger Eocene fauna. These are, among *Mesodonta*, *Hyopsodus paulus*; *Perissodactyla*, ?*Orohippus major*, *Palæosyops major* and *P. lævidens*; *Leurocephalus cultridens* gen. et sp. nov., *Amblypoda*, *Uintatherium leidyianum* sp. nov. and *U. princeps* sp. nov. The new species are *Megenecephalon* (Carnivora new genus) 1 sp.; *Hyrachyus*, 3 sp.; *Helaletes*, 1 sp. *Ithygrammodon* gen. nov., supposed to be Artiodactyle and related to the *Camelidæ*, 1 sp. *Crocodilus*, 1 sp. Of the above, the most interesting novelty is the *Leurocephalus*, which is doubtless a genus distinct from *Palæosyops*, although the authors have not seized its single character in their diagnosis. The most beautiful specimen is the *Uintatherium leidyianum*, of which the party obtained a nearly complete cranium and much of the skeleton. The excellent heliotype engraving which accompanies the report gives a good idea of the appearance of this extraordinary animal, whose place is evidently between the two extreme forms, *Uintatherium mirabile* and *Loxolophodon cornutus*. Other figures representing vertebræ and other parts of the skeleton will prove very useful. Several of the other species are represented by figures engraved by photographic process. We can only wish for a few representing the crowns of the teeth.

The fish-beds of Florissant, Col., yielded some fine specimens of several species, among which is a new *Trichophanes*.

The authors of this catalogue may congratulate themselves on having measureably mastered one of the most difficult branches of our palæontology, considered from the standpoint of literature and synonymy They have presented the results of their labors in a form which is available to their fellow workers. We conclude this notice with the single regret that they did not retain in MS. the compiled catalogue which closes the report. There are several reasons why this course should have been followed; one of which is that a large proportion of its names are as yet without authority, but are rather in the condition of those that fill sales catalogues of different kinds, than available for scientific purposes.

Packard's Guide to the Study of Insects.[1]—We notice the present edition for the purpose of drawing attention to certain changes and suggestions which may prove of interest to those who do not possess the last edition, and for this purpose quote as follows from the preface. "More important additions and alterations have been made in this edition than in any previous one. The author has decided to consider the Hexapoda, Arachnida

[1] *Guide to the Study of Insects and a Treatise on those injurious and beneficial to Crops.* For the use of Colleges, Farm-schools and Agriculturalists. By A. S. Packard, Jr. M. D. With fifteen plates and six hundred and seventy wood-cuts. Sixth edition. New York Henry Holt & Co. Boston: Estes & Lauriat. 1878. 8vo, pp. 715.

and Myriopoda as sub-classes of Tracheata, and consequently what have been in former editions regarded as sub-orders are called orders. The Thysanura, moreover, are separated from the Neuroptera and regarded as a distinct order, comprising synthetic types with features allying them to the Orthoptera, Neuroptera and Myriopoda. They are divided into two sub-orders, the lower the *Collembola* of Lubbock, and for the higher suborder, comprising the Lepismatidæ and Campodeæ, the term *Cinura* (κινεω, to move; ουρος, tail) is proposed. The terms *tenaculum* and *elater* are adopted from the author's previous writings for the "holder" and "spring" of the Collembola; and for the sucker, or organ secreting the adhesive material characteristic of the Collembola, the term *collophore* is proposed.

"Brief mention has been made of the *Pycnogonidæ*, which are placed among the mites; also of the Peripatidæ, which are given a place next to the sucking Myriopoda, since they have been proved by the researches of Mr. Moseley to be Tracheata."

THOMAS' NOXIOUS INSECTS OF ILLINOIS.[1]—This voluminous report evinces the activity shown the past year in Illinois as regards the prevention and cure of injuries from injurious insects. The State entomologist has employed Prof. G. H. French as general assistant, Miss Nettie Middleton as office assistant, and Miss Emily A. Smith as special assistant for the north-western part of the State. Over a hundred pages are devoted by Prof. Thomas to insects injurious to corn; an excellent report by Miss Smith relates also to corn insects and to the maple-tree bark-louse, while the second half of the report is devoted by Prof. French to a description of the butterflies and moths, with their caterpillars, especially injurious in Illinois. The volume is well calculated to interest and instruct the people of the West in economic entomology, and, we think, is an improvement on last year's report.

LOCKYER'S GUILLEMIN'S FORCES OF NATURE.[2]—By its general accuracy of statement, simplicity and clearness of style, and the excellence of the wood-cuts and full page illustrations, this work in its English dress, will commend itself to those naturalists who wish to broaden their field of study and to ascertain the nature of the environment by which the life of the globe is surrounded. From many points of view the naturalist and geologist will need to review and utilize his knowledge, or if that be wanting, acquire some idea of the physical phenomena of nature.

[1] *Seventh Report of the State Entomologist on the Noxious and Beneficial Insects of the State of Illinois. Second Annual Report.* By CYRUS THOMAS, Ph.D., State Entomologist. Springfield, Ill., 1878,. 8vo, pp. 290.

[2] *The Forces of Nature.* A popular introduction to the study of Physical Phenomena. By Amédée Guillemin. Translated from the French by Mrs. NORMAN LOCKYER, and edited with additions and notes by J. NORMAN LOCKYER, F.R.S. Illustrated by nearly five hundred engravings. London, Macmillan & Co., 1877. 8vo. pp. 725. 18 numbers, one shilling a number.

The work after having had, as the English publishers claim, an "enormous circulation" in France, and two very large editions in England, is republished in England in eighteen parts, "at about half the original cost." It is divided into seven books, treating of gravity and attraction, sound, light and color, heat, magnetism and electricity, the rainbow, the rise of clouds and fogs, and atmospheric meteors, with a full index. A brief appendix contains the reprint of a paper by Prof. Henry Draper on the discovery of oxygen in the sun by photography, and a new theory of the solar spectrum.

LETTER FROM O. C. MARSH, ETC., TRANSMITTING THE REPORT ON THE SCIENTIFIC SURVEYS OF THE TERRITORIES, ETC.[1]—We have received a copy of this document, which consists of the report of a committee which was appointed by Prof. O. C. Marsh under the following circumstances: Certain persons, not friendly to some of the U. S. Geological Surveys as at present constituted, succeeded in having included in the Sundry Civil Appropriation Bill, of June 30, 1878, the following clause:

"And the National Academy of Sciences is hereby required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character under the War or Interior Department, and the surveys of the Land Office, and to report to Congress as soon thereafter as may be practicable, a plan for surveying and mapping the Territories of the United States on such general system as will, in their judgment, secure the best results at the least possible cost; and also to recommend to Congress a suitable plan for the publication and distribution of the reports, maps and documents, and other results of said surveys."

In pursuance of this act, Prof. Marsh, who is acting president of the Academy, pending the appointment of Prof. Henry's successor, selected a committee consisting of six gentlemen who were not personally connected with the surveys. Of the seven members of the committee, four were geologists, of whom the two younger and more capable members were known to desire changes in the personnel of some of the surveys. In accordance with the constitution of the National Academy, a committee may be appointed in the interval of the meetings, in response to a request of Congress, and such committee is not required to refer to the Academy for advice and assistance, but reports its conclusions to Congress direct, and its proceedings to the next meeting of the Academy. It is evident that reports made in this way lose much of their authority as utterances of the Academy, especially when, as in the present instance it has just been deprived of its president and has not yet secured the services of a successor.

[1] *Letter from O. C. Marsh, vice president and acting president of the National Academy of Sciences, transmitting, in obedience to law, the Report on the Scientific Surveys of the Territories made by the Nat. Academy of Sciences.* Senate Mis. Doc., No. 9.

The report of the committee makes three recommendations; as follows: First, that the geodetic surveying of the Territories of the United States be placed in the hands of one organization, and that that one be the United States Coast Survey, which they also propose shall be transferred to the Interior Department. Secondly, that all of the existing geological and geographical surveys be abolished, and that a new organization be created under the Interior Department, to be called the United States Geological Survey. Thirdly, the limitation of the duties of the Land Office to questions relating to the disposition and sale of public lands, their titles, the records, etc.

At first sight there is a simplicity and harmony about the plan thus recommended, which is pleasing to one's sense of order and fitness. The proposition for the unification of all geodetic work is every way reasonable, and we hope to see it adopted. So, also, with the plan of conduct of the Land Office. But as regards the geological work proper of the country, there is no such reason for consolidation. If the work be well done, it matters not to how many organizations it be confided, provided it be not duplicated, and of this there is now no danger. In fact, in view of the utter absence of reasonable grounds for the committee's proposition on this head, we seek for the presentation of some in the report, but in vain. We have now three or four extensive and complex organizations fully equipped at great expense, and ably manned, all doing work which is the admiration of the older countries, as well as of our own, which this committee proposes to snuff out of existence. And this while they are in the midst of their usefulness, and preparing to bring out work which is the result of years of preparation. The proposition seems especially absurd in view of the other fact, that the term of existence of Government supervision of this work is, at most, limited. One portion after another of the territory west of the 100th meridian will be entering the Union as States, and then the sustenance of the geological surveying will fall to the State Governments. It does, therefore, seem particularly unnecessary to create a new body for this object at this time. We can only account for the proposition in view of the universal truth that "some men labor, and other men enter into their labors."

The following summary includes the more important objections which occur to us:

(1.) The surveys as they now exist are the results of private effort and energy, and the force of personal interest on the part of their directors is an important element in their success. Remove this, and much of their working power is gone.

(2.) The territories will, before many years, become States, and the services of the General Government in surveying will be superseded by the State Govenments. It is therefore unnecessary to create a new organization to accomplish a work which is

now in large part completed, and for which competent organizations already exist.

(3.) The present organizations are abundantly capable of doing the work, in the opinion of competent critics in America and Europe.

(4.) The existence of several distinct organizations is a guarantee of better work than where but one exists. The emulation which exists between different surveys, and the constant necessity for preserving each other's respect, secures a high standard of work, and prevents the development of a Beaurocracy which is foreign to our methods and tastes.

(5.) The objection raised on account of the duplication of work, ceases to exist with the proper division of territory between the Surveys.

(6.) No department of the U. S. Government should be precluded from entering on any geological or other scientific work germane to its objects.

(7.) The more numerous the surveys, the more numerous the avenues of publication of scientific work, an advantage highly appreciated by the savants of the country.—*E. D. Cope.*

RECENT BOOKS AND PAMPHLETS.—The Amateur's Handbook of Practical Information for the Workshop and Laboratory. New York, The Industrial Publication Co., 1878. 12mo, pp. 44.

Note Rectificative sur quelques Diptères Tertiaires et en particulier sur un diptère des marnes tertiaires (miocene inférieur) de Chadrat (Auvergne) La Protomyia Oustaleti qui devra s. appeler Plecia Oustaleti. Par M. Charles Brongniart. (Extrait du Bulletin Scientifique du department du Nord.) Avril, 1878. 8vo, pp. 9.

Note sur un nouveau Genre d'Orthoptère Fossile de la Famille des Phasmiens provenant des Terrains supra-houillers de Commentry (Allier) (Protophasma Dumasii). Par M. Charles Brongniart. 8vo, pp. 10, 1 plate.

Teratology, or the Science of Monsters. By M. M. Walker, M.D. A Lecture delivered before the Hahnemann Medical College of Philadelphia, Jan., 1878. 8vo, pp. 13. Illustrated.

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The Entomological Writings of John L. LeConte. Compiled by Samuel Henshaw. Edited by George Dimmock. Cambridge, Nov., 1878. 8vo, pd 11.

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Descriptions of supposed new species of Birds from the Islands of Granada and Dominica, West Indies. By Geo. N. Lawrence. (From the Annals of the New York Academy of Sciences, Vol. i. July, 1878). From the author.

Ichthyologische Beitrage (vi). From Vol. lxxvii of the Sitzb. der K. Akad. der Wissensch. I. Abth., 1878. 8vo, pp. 14, Taf. iii. The same (vii). From Vol. lxxviii, *ibid.* 8vo, pp. 24, 1878. By Dr. Franz Steindächner. Vienna. From the author.

Note sur l'absence du Systeme Diestien aux environs de Bruxelles, et sur des observations nouvelles relatives au Systeme Lækenien. Par G. Vincent et A. Rutot. 8vo, pp. 13. Liége, 1878. From the authors.

Paléoethnologie ou L'Antiquité de L'Homme dans les Alpes-Maritimes. Par Emile Rivière. Planches en chromolithographie par J. Pilloy, gravures sur bois par Guzman. 4to. Livraisons i, ii, iii. Paris, J. B. Ballière et Fils, 1878–79. From the author.

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GENERAL NOTES.

BOTANY.

Association of an Inconspicuous Corolla with Proterogynous Dichogamy in Insect-fertilized Flowers.—Mr. A. S. Wilson, at the last meeting of the British association, read a paper on this subject. He said that there is a class of flowers represented by the common figwort (*Schrophularia nodosa*) which are shown, by their secreting nectar and emitting odors, to be dependant on the visits of insects for their fertilization, and not on the wind, and yet do not possess a conspicuous colored or marked corolla for the guidance of insects to the flowers. Moreover, the flowers are in them not massed together to gain additional conspicuousness, as in highly colored flowers, like heaths, foxgloves, gladiolus, etc. Highly colored conspicuous flowers are usually proteranhous, *i. e.* the anthers are matured before the stigma, and as flowers are usually developed from below upwards, it follows that in any given plant the lower flowers will have shed their pollen and have their

stigmas ready to receive it by the time the upper flowers are beginning to shed their pollen. In this inconspicuous class, on the other hand, the lower flowers will be in the second or male stage when the upper flowers are as yet in the younger or female stage. Now it is clear that an insect visiting such flowers, must adhere to the habit of the bee, which invariably begins at the lower flower on a stalk and goes upwards, taking each flower in regular succession. By this means it invariably enters first a female flower and there deposits the pollen it brings with it from another plant. Were the bee to reverse this order, the whole elaborate arrangements of many plants for cross-fertilization would be upset, for the bee would simply transfer pollen from the upper male flowers and deposit it on the lower female ones. This would be fertilization by flowers of the same plant, and this Mr. Darwin has shown to be little or no better than self-fertilization. In the case of the inconspicuous flowers, where the opposite condition obtains, a bee would frustrate fertilization by adhering to its ordinary ascending habit. Mr. Wilson's observations of a wasp visiting these plants indicate that the wasp begins at the top flower and proceeds downwards—so that they are adapted specially to such insects, and as wasps are generally predatory in their habits, and not entirely vegetable feeders, as bees are, it is probable that, like other carnivorous creatures, their perceptions of vision and scent are keener; hence wasps can probably find these obscure flowers quite as easily as a bee can a highly-colored one. The plant, therefore, finds that the material can be more economically utilized than in the production of a colored corolla just as in the case of self-fertile cleistogamic flowers.

BOTANICAL NEWS.—At the last meeting of the British Association Mr. A. S. Wilson read some notes on dimorphic plants. The plants referred to in this paper were *Erythræa centaurium*, which appears from a microscopic examination of the pollen to be a dimorphic plant like the primrose or bog-bean; and *Silene acaulis*, which presents three forms—a male, having stamens only, a female, with rudimentary stamens and perfect pistils, and a perfect hermaphrodite form, having both complete. In this respect it resembles *S. inflata*, which, according to Axell, is triœciously polygamous.

Mr. Wilson also remarked on "Some Mechanical Arrangements Subserving Cross-Fertilization of Plants by Insects." This paper had reference to the three plants, *Vinca minor*, *Pinguicula vulgaris*, and foxglove—and was a description of latch-like arrangements in the latter two, and a knee-shaped bend in the first, which when depressed by an insect entering the flowers, cause the pollen to be deposited on the insect, and, in the case of *Vinca*, to smear the pollen with viscid matter from the circumference of the curiously-shaped disc forming the lower part of the stigma.

Dr. Bayley Balfour referred to certain peculiarities in the struc-

ture of the *Naiidaceæ*. He especially described the arrangement of leaves in the genus *Helophila*. In this marine tropical phnæogam, the stem is a creeping jointed rhizoma; at each joint occurs a pair of sheafing scale leaves. No foliage leaves occur on the main axis. In the axil of one scale leaf of each pair arises eccentrically a lateral secondary shoot, which is a jointed rhizoma like the parent, and the first pair of leaves upon it is a pair of foliage leaves, the succeeding leaves on this axis are all scale leaves. From these secondary axes tertiary ones arise, which again repeat the process. Thus the foliage leaves in these plants only occur as the first pair of leaves on the lateral shoots. This is probably unique in the vegetable kingdom. The homologies of the parts of the male and female flowers were also pointed out.

The *Bulletin* of the Torrey Botanical Club for October (which was late in coming) contains several notes by Messrs. Eaton, Underwood and Gilbert, on the ferns of the United States.

In the *Botanical Gazette* for November, Fendler's Ferns of Trinidad are noticed by Prof. Eaton. The leaves of *Darlingtonia californica* and their two secretions are described by Mrs. R. M. Austin.

ZOÖLOGY.[1]

ON THE ORIGIN OF BILATERAL SYMMETRY AND THE NUMEROUS SEGMENTS OF THE SOFT RAYS OF FISHES.—As is well known, the soft fin-rays of *Acanthopterous* fishes and all or most of the fin-rays of *Malacopterygians*, are composed of two bilaterally symmetrical ossified and more or less completely segmented halves, semicircular in section, each having a groove on its inner face to receive between them a cartilaginous medulla. Their embryological history shows that the process of ossification is progressive from without inwards, or in the language of recent authorities it may be styled ectosteal.

Viewed in a non-teleological, or in the light of what seem to be the probable mechanical (dynamical) differentiating causes, their origin becomes extremely simple. No type of vertebrate limb has such exceedingly short and numerous segments in relation to its total length. In extreme contrast with them we may place the digital wing-elements of the *Chiroptera* and *Pterosauria*, and of these it may be said no vertebrate types exhibit such excessive elongation of the digital elements in proportion to their aggregate length. Contrasting their habitual modes of use in relation to their surroundings, we find the media, water and air, in which the two, respectively fins and wings, are used differ as widely in respect to density. That such difference in structure should accompany such widely differing conditions would seem to be caused by those conditions. Then, like those types which perambulate over approximate planes, there are no definite points of im-

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

pact, hence we find no specialization of structure for counteracting, or rather for preventing injuries which such impacts might cause, as we find in hoofs, corneous pads or soles, nails and claws, but the whole impinging surface of the osseous supporting structure is differentiated or developed in degrees; in general terms it is most developed proximally and gradually shades off, becoming least developed distally. Again, in the fish but little osseous tissue is found developed anywhere except in opposition to the lines of greatest mechanical resistance encountered in locomotion, so that paradoxical as it may appear, it looks as though the means of locomotion have actually been cumulatively and phylogenetically developed by the means used to effect the movements. In this way we may probably explain the bilaterally symmetrical disposition of the osseous part of the soft rays which are thickest where the resistance is theoretically the greatest. On the other hand, the volant types, which are provided with interdigital alar membranes, have their bones of the ordinary type, that is, ossified alike on all sides, hence essentially tubular; in the *Pterosauria* the walls of the tubular digital bones are very thin but dense, which is in agreement with the requirements of their environments and is probably caused by them.

As a non-teleological summary the following principles are derived:

1. In proportion to the degree of resistance or density of the medium traversed, do osseous segments tend to be abbreviated and *vice versa*. (This tendency is only overcome by means of relatively great muscular specialization, as in the long-limbed Anourous Batrachians and Ungulate Mammals, but even here the remote impinging elements tend to become shorter.)

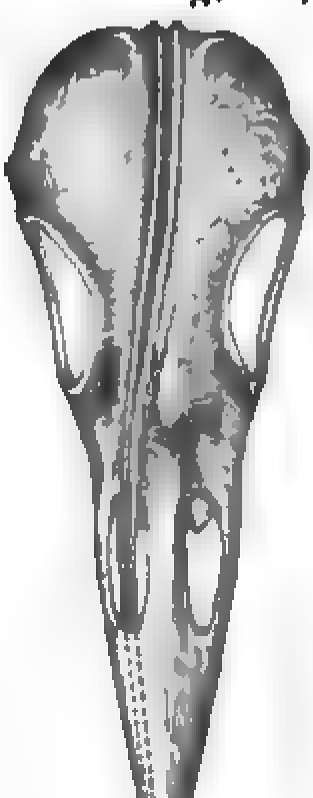
2. The tendency to the development of osseous structure in the lines of greatest resistance seems to be an invariable phenomenon attending the exhibition of vertebrate life on our planet, and in this way bilateral symmetry of the osseous halves of soft fin-rays is accounted for, and on the self-evident assumption that the rythmical efforts exerted in opposite directions in overcoming inertia are potentially alike, the morphological effects tending from this cause to be repeated on opposite sides of a part or the whole of the body as the case may be. The general truth that bone is developed ecto-chondrially is accordingly in large part explained.

The segmentation of limbs, of the notochord of arthropods, etc., into series of phalanges, vertebræ, osteomeres, neuromeres, myomeres, renomeres, antimeres, somites, etc., becomes clearly subordinate to the foregoing.

It will be apparent to those familiar with a sufficiently great number of animal types and structural features that the above, when taken together with the doctrine universal of mutual retroactivity existing between living forms and their environment, will explain away deductively the origin of a great majority of the

morphological features of those living forms. A so modified Lamarckian philosophy of animal differentiation seems reasonable, and a most overwhelming mass of evidence exists in its favor; varieties, species, genera, etc., presenting only the milestones, as it were, of the great non-teleological and universal process of evolution by means of knowable and discoverable causes originating in the mechanical and dynamical conditions which surround living organisms, and by which they are related to the cosmos. This, however, goes without saying, that types may not be more or less persistent from the persistence of a uniformity of conditions.—*John A. Ryder.*

Some New Points in the Construction of the Tongues of Woodpeckers.—The tongue of the woodpecker is long, flat, horny, and at its end armed with a number of short barbs. By means of a peculiar mechanism it can be suddenly pushed out, so as to reach far beyond the point of the bill. The two cartilaginous appendices to the hyoid bone, known as "the horns," are curved into wide arches, each horn making a loop down the neck, and thence bending upwards, sliding around the skull down on the forehead. Through a peculiar muscular arrangement of the sheaths, in which the horns slide, they can be retracted down on the occiput, and will then work as springs on the base of the tongue, forcing it out with great velocity. These peculiarities in the construction of the tongues of woodpeckers, have long been known, and the above description is pretty nearly the same as that given by Claus in his "Grundzüge der Zoologie."



The skull of *Gecinus viridis* L., showing the asymmetrical position of the horns (cornua linguæ) and their extension through the nasal fossa to the end of the cavity covered by the intermaxillare.

Some years ago I was engaged in Sweden, in preparing zoötomical specimens, among which were some woodpeckers' heads, viz: one *Picus tridactylus*, two *P. martius* and more than twenty *P. viridis*.

In every one of them I noticed a peculiar *asymmetric arrangement* of the horns, which, upon reaching the upper part of the skull, met in a broad groove of its surface, and following the groove, are turned towards the right side of the forehead, running down between the right orbit and the crest, which is raised along the median line of the lower part of the forehead, slightly inclined towards the right side.

In *P. tridactylus* and *P. martius* I found that the horns end above the base of the forehead. But in *P. viridis* they extend through the nasal fossa into the cavity, which is covered by the

os intermaxillare, their ends reaching all the way out to the extreme end of the said cavity.

Since that time I have had no opportunity of making further investigations in this matter. It seems probable that such an arrangement as found in the tongue of *P. viridis* would enable the bird to project its tongue further and with greater velocity than those that have shorter horns. Therefore I would suppose that *P. viridis* feeds on larvæ which live in the deeper parts of the wood and are quick in their motions. This, however, I must acknowledge to be merely a supposition, but it is a point worthy of the attention of zoölogists.—*Dr. Josua Lindahl.*

Amphioxus and Lingula at the Mouth of Chesapeake Bay.—In his account of a foundation of a zoölogical laboratory at the mouth of Chesapeake bay, as a summer school of instruction for the students of John Hopkins University, Prof. W. K. Brooks, in the third Annual Report of the University, thus speaks of the scientific results of the summer's work, and of the discovery of the early stages of Amphioxus and Lingula. We shall elsewhere notice the workings of this laboratory:

"The amount of advantage which zoölogical science can derive from the discovery and description of new species is very slight as compared with that which is gained by the careful study of the whole life-history of any form of life—old or new. As this work can be done only where the living animals can be had, it is properly *laboratory* work, as distinguished from *museum* work, or the identification of species.

"I accordingly made no attempt to find and describe new forms, but devoted all our time to the careful study of a few important species; selecting for this purpose, from among those which were abundant at our station, the ones a knowledge of which is most desirable to science. I may say, however, that two of the forms which we selected for careful study were new additions to the fauna of this region. One of these, *Amphioxus*, was studied by Mr. Rice. *Amphioxus* is a small worm-like animal, the lowest of the vertebrates, and it is of very great scientific interest, since it has preserved many evidences of a relationship to various groups of invertebrates, and thus serves to bridge over the gap which was supposed by Cuvier and Agassiz to separate the vertebrata from all lower forms of life. Its embryology, which may be termed the key to the embryology of all the higher animals, has been ably studied by several of the most distinguished zoölogists of Europe, and a number of papers have appeared upon the subject within a few years. We fortunately found several larvæ which had passed beyond the stages studied by these naturalists, but which had not yet acquired the adult characteristics. Mr. Rice succeeded in keeping these alive, and was thus able to supply the information necessary to complete our knowledge of its development. He also made very interest-

ing observations upon the habits of *Amphioxus*. *Amphioxus* has been found upon the coast of North Carolina, and last winter one of the assistants of the Smithsonion Institution discovered it in the Bermudas; until this summer these were the only instances of its occurrence upon this side of the Atlantic.

"Another important form of life which was carefully studied, is *Lingula*, one of the Brachiopods, a group which has been of great importance during past geological periods, but has now almost entirely disappeared. *Lingula* itself has persisted unchanged from the time of formation of the oldest fossiliferous rocks, and is one of the first living things of which we have any knowledge. As *Lingula* has not before been found under circumstances which admitted of careful study, almost nothing was known of its development, but I was able to trace its life-history this summer from a very early stage up to the adult form, and to show that, old as it is, each individual, from the time of the lower Silurian up to the present time, has transmitted to its children a developmental record which proves that *Lingula* itself is the descendant of a much older form."

Singular Habit of a Meloid Beetle.—I have noticed for the past two seasons a singular habit of one of the Meloid beetles, *Tricrania stansburii*, which, so far as I am aware, seems somewhat at variance with the known habits of this family. Previous to the spring of 1877 this beetle was very rarely taken, and is yet, I believe, not common in collections. In April of that year a few were caught on the Kansas plains, slowly flying over the uplands on warm sunny days. In the latter part of the month, however, a number of specimens were observed in the bottom of a wagon bed that had been used to collect buffalo bones for the market; upon further investigation large quantities were obtained from the decaying buffalo and antelope bones on the high prairies. They chose only the cancellous tissue of the limb bones, or more especially the ethomidal and sphenoidal regions of the skull in weathered skeletons. None were ever taken after the latter part of May. In early May of the present year several were taken from a decayed railroad tie in the vicinity of Como, Wyoming; one female having apparently just deposited a mass of eggs in a warm fissure.

The large number upon the plains, both of species and individuals, in this genus, together with *Meloe*, *Nomaspis*, *Macrobasis*, *Epicauta*, *Pyrota*, *Zonitis*, *Nemognatha* and *Gnathium*, and the parasitism of several of these, as shown by Prof. Riley, upon the locusts, will render a further elucidation of the habits of *Tricrania* an interesting one.—*S. W. Williston.*

New Carcinological Papers.—Mr. E. J. Miers, of the British Museum, publishes a "Revision of the Hippidea" in the Journal of the Linnæan Society, Vol. xiv, in which he enumerate six

genera and twenty-two species from the whole world. This author rejects Dana's view of placing these Crustacea immediately beneath the Corystoidea, but would rather follow Lamarck and Milne Edwards and connect them with the Oxystomatous Crustacea through the family Raninidæ.

These Crustacea are represented on our coast (south of Cape Cod by *Hippa talpoida* Say, which our author is inclined to consider the same as *Hippa emeritus* of Fabricius (*Cancer emeritus* L.).

A second paper by the same author on a collection of Crustacea from the Gulf of Akabo, at the northern extremity of the Red Sea (Annals and Mag. Nat. Hist., Nov., 1878), has some interesting remarks upon some species of the difficult genus Trapezia. —*J. S. Kingsley, Providence, R. I.*

MODE OF DRINKING OF THE RED SQUIRREL.—In a late camping excursion in the wilderness of Wisconsin, on the Upper Manominee, we frequently met the common red or Hudson's bay squirrel (*Sciurus hudsonius*) swimming the river, when they were easily taken into the canoes. Several of the ladies of the party interested themselves by confining the squirrels in boxes, and then feeding and watering them; in most cases they gnawed their way out and were gone the next morning, but not all. They were observing girls, and a discussion soon arose among them, whether the squirrels drank water by the sucking or by the lapping process, which was finally referred to me for decision. Miss H. had one which had already become quite domesticated, and would come at her call to eat and drink, which was done through a small orifice not large enough to admit the passage of the whole head. A little triangular cup was formed of a leaf and filled with water, and one angle presented to the opening and the squirrel called. He instantly came, projected his nose out about half an inch to the water and commenced drinking. This, beyond all doubt, was done by lapping up the water, as is the habit of the dog and the cat, but the process was so exceedingly rapid as to require a very careful scrutiny to detect it with certainty. The position was very favorable for accurate observation, and the point was finally yielded by the doubters.

This may be familiar to naturalists, but I do not remember to have observed any examination as to the modes in which the various quadrupeds drink, nor had the subject previously occupied my attention. Do all the rodents lap their drink like the dog and the cat families? Has any naturalist undertaken to settle the question as to what quadrupeds drink by lapping and what by sucking the water? It seems to me that these are characteristics of scientific importance, and worthy of attention.—*J. D. Caton, Ottawa, Ills.*

CAND. ROBT. COLLETT, of the University of Christiania, has lately published a list of Norwegian Zoölogical literature for 1877, of which the following is a summary:

R. Collett, "On *Myodes lemmus* in Norway." Some remarks on the migratory habits of the Norwegian lemmings (Journ. Lin. Soc. Zoöl. Vol. xiii., pp. 327–334). *Id.*, three papers containing contributions to the Ornithology of Norway (Proc. Zoöl. Soc., Lond., 1877, pp. 43–46; Nyt Mag. f. Naturv. Vol. xxiii, No. 4, pp. 85–225; and Forh. Vid. Selsk. Christiania, 1877, No. 5; pp. 4). *Id.*, a synopsis of fifty-nine species of birds from Madagascar and Bourbon, presented to the Christiania Museum (Forh. Vid. Selsk. Christiania, 1877, No. 6; pp. 20).

J. Koren and D. Danielsen, descriptions of six new species of the gastropod tribe *Solenopus* M. Sars (Arch. f. Math. Naturv., Vol. ii, No. 2, pp. 120–128).

H. Friele, "Preliminary report on Mollusca from the Norwegian North Atlantic Expedition in 1876," with one autograph plate (Nyt Mag. f. Naturv., Vol. xxiii, No. 3, pp. 1–10). *Id.*, a paper on the radula of Norwegian *Rhipidoglossa*, with four autograph plates (Arch. f. Math. and Naturv., Vol. ii, No. 2; pp. 217). *Id.*, "The development of the skeleton in the genus *Waldheimia*," with six lithograph plates (Arch. f. Math. and Naturv., Vol. ii, No. 4, pp. 380–386).

J. Sparre Schneider, a report on the Lepidoptera collected by the author near Drammen in 1876 (Forh. Vid. Selsk. Christiania, 1877, No. 4; pp. 30).

H. Siebke, "*Enumeratio Insectorum Norvegicorum. Fasc.* iv, *catalogum Dipterorum continens.*" Ed. J. Sp. Schneider. 255 pages (University programme, 1877).

V. Storm, a report on the Museum of "Videnskabernes Selskab," and some notices of rare Coleoptera, found around Drontheim (Det Kgl. N. Vid. Selsk. Skr. i 19 Aarh., Vol. viii, No. 4; pages 131–162).

G. O. Sars, on the *Myside* of the Mediterranean, with thirty-six autograph plates (Arch. f. Math. and Naturv., Vol. ii, No. 1, pp. 10–119). *Id.*, *Prodromus descriptionis crustaceorum Pycnogonidarum, quæ in expeditione Norvegica, anno* 1876, *observavit* (Arch. f. Math. and Naturv., Vol. ii, No. 3; pp. 237–269).

D. Danielson and J. Koren, a synopsis of the *Echinodermata*, collected in the Norwegian expedition to the North Atlantic, in 1876. Several new species, among them one crinoid, *Iycrinus carpenteri*, from a depth of nearly 1500 fathoms in a temperature of — 1.6° C; three lithograph plates (Nyt Mag. f. Naturv., Vol. xxiii, No. 3; pp. 45–83).

J. Koren and D. Danielsen, "Fauna littoralis Norvegiæ," Part III, with sixteen plates, pp. 163, folio. Bergen, 1877. This volume forms the third part of the important work, of which the first part was published in 1846, by the late Prof. M. Sars, and the second in 1856, by M. Sars, J. Koren and D. Danielsen. The third part contains seven separate papers, viz.: 1. New or little known *Cœlenterata*, by M. Sars; ed. G. O. Sars. 2. New *Echinodermata*,

by M. Sars; ed. G. O. Sars. 3. New Norwegian *Cœlenterata*, by Koren and Danielsen. 4. Norwegian *Pennatulidæ*, by Koren and Danielson. 5. New *Bryozoa*, by Koren and Danielson. 6. Norwegian *Gephyrea*, by Koren and Danielson. 7. A new species of the genus *Pennella*, by Koren and Danielson.—(*J. L*).

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—Dr. George A. Otis, the curator of the U. S. Army Medical Museum, writes the following with reference to the work done at the museum under his charge: "Since January 1, 1878, Section IV, of the Army Medical Museum, has received specimens numbered from 1830 to 1952, inclusive, and comprising skeletons, crania and calvaria of American origin, with the exception of fifteen New Zealand calvaria transmitted from the Smithsonian Institution. These specimens have been carefully prepared, numbered and mounted; the principal measurements, in each case, made and recorded. Among the additions to the complete skeletons of American Indians was a series of seven Sioux, exhumed by Assistant Surgeon Corbusier; specimens from the shell-heaps of Florida, from Colorado and from Tennessee, of supposed pre-historic date, are of especial interest." The immense amount of work required by the Medical History of the War has exhausted all the funds appropriated for this institution. But Dr. Otis, with his trained assistants, has measured and mounted every important cranium which he has received, and has reconstructed from fragments many pre-historic skulls, an art in which he is exceedingly skillful. As soon as time and funds will allow, the results of these measurements will be laid before the scientific world.

The Rev. S. D. Peet, editor of the *American Antiquarian*, sends us his Prospectus, and it gives us great pleasure not only to draw attention to it, but to urge upon all lovers of American archæology to make sacrifices to sustain it Mr. Peet, without State or Government patronage, has for years given his leisure freely to aboriginal history. It is due to him as well as to the subject which we love in common, that he be not left alone in the matter. The brilliant success achieved in anthropology in England and Germany, but most of all in France, is due mainly to the interest awakened by the periodicals devoted solely to this one subject. The advantage of a special organ ever disseminating our efforts throughout all the periodicals of the country is apparent to all. Mr. Peet's address is at present Unionville, O.

The New York *Herald*, of November 5th, contains a review of Col. Mallery's paper on the supposed decrease in the number of our aborigines. Having once drawn attention to this paper, our space and our duty to the truth will not allow us to refer to it again, lest mistaken zeal rob the truth of its reward. Col. Mal-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

lery meant to say, and did say, that the Aborigines of America have been overestimated in numbers, that many tribes have been partly or wholly destroyed by whisky, disease and persecution, that others, after the first shock of contact, had continued to increase, and that, on the whole, there is not much difference between the present number of Indians and that of the "Discovery." The main argument of Col. Mallery was to show that, since the "necessary withering before the white man" is a fallacy, all efforts to help him to destruction are cruel and unpardonable.

We take great pleasure in recording the discovery of a large obsidian quarry, the largest yet found in America, in the Yellowstone National Park. Near the head of the middle fork of Gardiner's river, in the north-western part of the park, deposits of this rock nearly 600 feet in thickness and of unknown horizontal extent, were found. The discovery is reported by Mr. W. H. Holmes, assistant geologist of the Hayden Survey, who reports the finding of whole and broken implements, flakes and cores in great abundance.

In the November number of *Science News*, Dr. C. C. Abbott gives some valuable hints to collectors how to proceed in order to realize the full benefit of their work. Such cautions are exceedingly timely, coming from one who has devoted so much time in obeying his own instructions.

Dr. Emil Schmidt, of Essen, contributes to Archiv für Anthropologie, 1878, Parts 1, 2, an article of forty-two pages, on the pre-historic copper implements of North America. The article is illustrated by three plates and fifty-three figures, and is abundantly furnished with foot notes referring to the best authorities on the subject.

Through the kindness of Prof. J. Duncan Putnam we are in receipt of advanced sheets of the forthcoming Proceedings of the Davenport Academy of Natural Sciences. Quite a large portion of the volume is devoted to a description of Mound excavations by Messrs Pratt, Gass, Palmer and Harrison. Mr. W. W. Calkins read a paper, Feb. 28th, on the Shell-heaps of Florida.

Prof. Ph. Valentine has published Vortrag über den Mexicanischen Calender-stein, gehalten am 30 April 1878, in Republican Hall vor dem Deutsch ges. wissenschaftlichen Verein. New York, 1878.

Mr. G. Laurence Gomme, honorary secretary of the English Folk Lore Society, has written to the secretary of the Smithsonian Institution asking coöperation in carrying out the aims of the society. Perhaps there is no country where the facts of primitive culture are so easily accessible as our own. In addition to the fertile field offered by our aborigines, we have the negroes of the South, and the myth-preserving peasantry transported to our shores from all the lands of the earth. The NATURALIST will be

foremost in encouraging this as it has been with other branches of anthropological study.

The first number of Vol. viii, of the *Journal* of the Anthropological Institute of Great Britain and Ireland, dated August, is an unusually interesting brochure. The paper which will prove most interesting to the general student is "On the coloring matter found in human hair," by H. C. Sorby. The author is begged to reconsider his statement that black hair is not made lighter by direct sunlight. Our black horses at the South all become a dirty brown color in August, and many will recall the foxy red hair of the little negroes that greeted the traveler at every wayside before the late war. Mr. W. St. Chad Boscawen makes a communication upon the Primitive culture of Babylonia, which reviews the evolution of the cuneiform writing. Other papers are: On the original range of the Papuan and Negrette races, by Francis A. Allen; The spread of the Slaves, Part 2, by H. H. Howorth.

The first and second quarterly parts of *Archiv für Anthropologie* for 1878, come at the same time. The paper on pre-historic copper implements of North America has already been noticed. The following titles may have some interest to special students: Upon the value of the frontal process (*spina frontalis squamæ ossis temporum, Stirnfortsatz der Schläfenschuppe*) as a race characteristic, by Dr. Ludwig Stieda; Upon the problem of the origin of marriage; Communications at the sessions of the Society of the Lower Rhine, by Prof. Schaafhausen; C. Von Baers' anthropological and geographical writings, by L. Stieda; Upon measuring and fixing the horizontal of the skull, by Prof. Schaafhausen. Bound up with *Archiv* are Nos. 9, 10 and 11 of *Correspondenz-Blatt*, giving a full account of the general meeting of the German Anthropological society at Constanz, 24–26 Sept. 1877. This is by far the most instructive part of the number, and lets us glance at the immense activity of our German brethren.

The October number of *Revue d'Anthropologie* contains the following original papers: Note on a pre-historic tumulus in Buenos Ayres, by Estasnilao Ceballos; Study of the Soninkes (Senegal), by Dr. Bérenger-Feraud; The Skulls of the blacks of India (tribe of Maravars), by E. Callamand; Note on the Bahnars (Cochin China), by Dr. A. Morice. The most valuable part of the number is that occupied by the description of the "International Congress of Anthropological Sciences; The following are given in full: Opening address, by Dr. Paul Broca; Report of anthropological societies, by M. Thulié; Report on general anthropology, by P. Topinard; Reports on ethnology, by MM. Girard de Rialle and Bordier; Reports on palæontology, by MM. G. de Mortillet, E. Cartaillac and E. Chautre; Report on demography, by M. Chervin.

The Société Impériale des Amis des Sciences Naturelles

d'Anthropologie et d'Ethnographie de Moscow has not only taken an active part in the Universal Exposition, but has also published a pamphlet giving a brief sketch of the society and the work which it has done for the ethnology of the countries within Russian territory.

GEOGRAPHY AND TRAVELS.[1]

UNKNOWN AFRICA.—M. H. Duveyrier has recently read a learned paper before the Paris Geographical Society in which he divides the unexplored portions of Africa into six great regions. These regions are: 1. The Sahara and the Libyan Desert, measuring 5,750,000 square kilometres, and notwithstanding its desolate aspect containing in its ancient populations and rich oases much of great interest. 2. In the west the country between the Joliba and the coast of Guinea, covering the surface of 1,200,000 square kilometres. 3. In the center north of the equator the upper courses and the sources of the Benué and the Shari composing an area of 800,000 square kilometres in which to seek to complete our knowledge of the basins of the Nile and the Shari, and to discover the sources of the latter and those of the Benué. 4. In the southern equatorial zone adjacent to the preceding and embracing the head waters of the Nile, the sources of the Ogowé and the basin of the Congo, extending over 2,000,000 square kilometres, some of the greatest problems of African geography remain to be decided. 5. In the south the basin of the Cunene and the districts about Angola and Benguela. 6. Finally, in the east, the region which forms a triangle culminating in Cape Gardafui whose interior is totally unexplored, and presents subjects of investigation not only geographical, but also historical of the highest interest.

Adding together the areas of these six great lacunæ we find they amount to upwards of 11,000,000 square kilometres—more than one-third of the African continent. But there is no reason to be discouraged at this large figure. Since the beginning of the present century the exploration of Africa has progressed at a mean rate of 234,285 square kilometres per year, and if it goes on at this rate, the whole of the African interior ought to be known in less than forty-eight years. But this calculation takes no account of the geometric progression of the figure of these discoveries which now produce in one year more than in the first twenty years of the century.

AFRICAN EXPLORATION.—Dr. Gerhard Rohlfs arrived at Tripolis on the 24th of October last. He expects to proceed early in December to Kufrah and thence to Wadai. He will then endeavor to trace the rivers Shari and Benué to their sources, and to explore the region intervening between them and the rivers

[1] Edited by ELLIS H. YARNALL, Philadelphia.

Ogowé and Congo. He is accompanied by a zoōlogist, Dr. Stecker. The German African Association has granted him $7,500, and the German Emperor has entrusted him with valuable presents for the ruler of Wadai, in recognition of the kindness shown Dr. Nachtigal.

M. Paul Solleilet, who endeavored a few years ago to open up a commercial route between Algiers and Senegal, started from Bordeaux in the early part of 1878, on a second expedition with the same object for Saint Louis in Senegal. From there he proceeded to Backel, 250 leagues from the mouth of the Senegal river. Leaving there on the 8th of June, he arrived at Kuniakaro on the 23d of that month. When last heard from he was on the point of starting for Sego on the Niger. He proposes to winter in that town, and descend the river as far as Timbuktu in the ensuing spring. From thence he hopes to go to In-Salah and from thence to Algiers.

The feasibility of connecting the depression of the Shot-el-Jerid with the Mediterranean, and thus flooding the Algerian Sahara, is being investigated by Capt. Roudaire at the expense of the French Minister of Education. He has with him Dr. André who will examine into the natural history of the country.

The Portugese African Expedition, under Major Serpa Pinto, left Benguela on November 12, 1877, for Bihé, and reached the latter place in the following March. From particulars gathered by the *Academy* from Lisbon journals, we learn that they found the porter-difficulty even greater on the west than on the east coast, because as a rule the natives are only willing to engage for short journeys and specific destinations. At Bihé the explorers resolved to separate into two parties; Messrs. Capello and Ivens starting in a northern direction, whilst Major Serpa Pinto, on May 18, 1878, was on the eve of departing for the Upper Zambesi, intending to reach Zumbo early next year. This journey is likely to be very difficult, owing to the small escort and limited amount of goods taken and the hostile character of the tribes to be encountered. He proposes first to explore the region between the Cubango and the Zambesi. The geographical and meteorological observations already obtained are said to be very interesting. The Cubango has its source at a great distance west of Bihé, near that of the Cunene at Bailundo. The streams flowing to the west directly to the sea, or north into the Quanza, or south into the Cunene, have their sources in the vast marshy depressions of the country, between 12° 30′ and 13° S. latitude.

A successful experiment in the introduction of trained elephants from India into Africa has been made this year by Col. Gordon in Egypt. The elephants were first taken to Khartum and thence marched to Duffli, where they were employed in carrying all kinds of heavy goods. During their march they swam across the Nile three times. A portion of their journey from the

Sobat to Bahr was over territory never before traversed. The negroes along the line of march were frightened by them and made no attempt to attack the party. The elephants have gradually learned to live on leaves and grass as the wild elephants do, and keep in first rate condition. Col. Gordon consequently advises travelers to the interior from Zanzibar to use elephants, and thus avoid the necessity for a host of porters—a never ending source of delay and annoyance.

The Abbé Debaize, for whose scientific mission to Central Africa the French Government has apportioned a sum of 100,000 francs, reached Zanzibar early in June of last year. After the inevitable delay in obtaining porters and supplies, he started at the head of a caravan of 400 persons from Kikoka near Bagamoyo, on August 6th, and was last heard from at Mpwapwa, on September 1st. He has a good knowledge of Arabic, Coptic and of some East African languages, and has recently received instructions in Natural History from Milne-Edwards and from Capt. Mouchez, of the Paris Observatory, for astronomical observation.

The Belgian East African Expedition sent out under the auspices of the International African Association, at Brussels, after very great delay and several changes in its corps (caused by the death of two and the resignation of other members), and now conducted by M. M. Cambier, Wantier and Dutrieux, set out from Bagamoyo on July 4th. The Expedition included probably over 500 natives, of whom, however, 325 soon deserted with a large quantity of valuable goods. Leaving his companions to obtain other porters in place of the deserters, M. Cambier pushed on by a route half way between those of Mr. Stanley and Mr. Price to Mpwapwa. On August 13th, he started for Urambo in Unyamwesi where he contemplates founding the first of the "*stations hospitalières et scientifiques.*" Dr. Dutrieux had reached Mpwapwa on August 26th.

Ten Catholic Missionaries from Algeria also departed from Bagamoyo, on June 16th, 1878, and arriving at Mpwapwa on July 27th, separated—one party going to the Victoria Nyanza and the remainder to Ujiji. These missionaries have been practiced in the use of scientific instruments.

The *Academy* states that the London Missionary Society has heard of the arrival of its Tanganyika mission party at Ujiji. The march from Urambo, the capital of Unyamwesi, occupied but eighteen days, and the news "reached London in the short space of seventy-eight days, of which forty-five only were required for the transmission of the letter from Ujiji to Zanzibar, a distance of some 650 miles, and yet but eight years ago Dr. Livingstone was looked upon as lost, though he was residing at the former place."

Mr. Keith Johnston, the leader of the expedition which the Committee of the African Exploration Fund are about to dispatch

from the east coast of Africa to Lake Nyassa,[1] left England for Zanzibar on the 14th of November last. *Nature* states that his second in command, Mr. Thomson, has had an excellent training as a geologist, and it is expected that he will make important contributions to our knowledge of the geology of the region to be visited.

Sir Fowell Buxton stated, at a recent meeting of the Royal Geographical Society, that during the last year forty miles of the road from Dar-es-Salaam to the north end of the Nyassa have been made. The natives give no trouble and gladly use the road, but continue to walk in Indian file, so that the rapid growth of vegetation is but little impeded. One of the missionaries at Livingstonia, Lake Nyassa, departed, in June, 1878, on a journey through a portion of the country west of the lake.

The mission sent out by the Church Missionary Society to the Victoria Nyanza and Uganda has not been abandoned, although of the four who reached the lake in 1877, one, Dr. Smith, died of disease, and Lieut. Smith and Mr. O'Neil were murdered. The Rev. C. T. Wilson was at King Mtesa's capital, Rubaga, in Uganda, when the news of the massacre of his companions reached him, when he crossed the lake to Speke's Bay and made his way to Unyanyembe. The Society, however, has at least fourteen agents in the field, some of whom are carpenters, mechanics and agriculturists, and expect to have a chain of mission stations between Speke's Bay and Zanzibar. Mr. Wilson returned to Uganda in January, 1878, and up to the date of his last letter (May 9, 1878), was living comfortably at Rubaga, where he awaits the arrival of three colleagues sent out by the Nile route. From letters quoted in the *Academy* we learn that he has been favorably impressed with the quickness and skill in imitation of the Waganda. In his opinion they deserve the title of "the Chinese in Africa." They excel in basket making and in working in iron, copper and brass. They also dress skins beautifully. He also writes that the north-west corner of the Victoria Nyanza is thickly dotted with islands, some of which are fifteen miles long. The people say there are four hundred of them, and he has himself seen fifty or sixty. They are all called "Sasse" or "Sesse Islands," which may be translated "Isles of the Fishermen." These islands by dead reckoning extend to about S. lat. 0° 40′. In the winter and spring of 1877 the Nyanza slowly rose until the middle of May, when the maximum of two feet above the ordinary level was reached, and it then began to recede. In January, 1878, however, the water was within an inch or an inch and a half of its maximum in the previous May. The *Academy* remarks that in 1878, there was "a good Nile," which was not the case in 1877.

The Church Missionary Society, the *Academy* also states, has decided to despatch an expedition to the south-western end of the

[1] See AMERICAN NATURALIST for November, 1878, page 763.

Albert Nyanza, and in Dr. Behm's *Monatsbericht* in the October *Mittheilungen*, it is announced that the Swedish Mission Society, assisted by a wealthy English gentleman, proposes also to establish a station at Fatiko, northeast of the lake. The latest explorations have considerably reduced the dimensions of the Albert Nyanza. Romolo Gessi placed its southern limit at 0° 50′ N. lat. Stanley discovered the Beatrice Gulf at about 0° 25′ N. lat., and believes it to be a portion of a hitherto unknown body of water—the Muta Nzige, and not connected with the Albert. Col. Mason Bey, who last circumnavigated the Albert Lake, shows that its shape is different, and its dimensions even smaller than were supposed by Gessi. His compass survey was checked by four astronomical observations. The lake is rectangular, not elliptical, in shape, and Mason Bey places its southern limit at N. lat. 1° 10′. Both Gessi and Mason Bey agree that no large river discharges itself into the lake at its southern extremity, nor is there any communication with any other large lake. The *Athenæum* notices some views put forth on the subject by an Italian geographer, who suggests that the Albert Nyanza is simply a back water or reservoir of the Murchison or Victoria Nile, which would account for the varying dimensions of the lake. The *Athenæum* also doubts if the supposed isolation of the Tanganyika from the basin of the Albert is yet satisfactorily proved.

SUMMARY OF THE FIELD WORK OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, UNDER PROF. F. V. HAYDEN, DURING THE SEASON OF 1878.—During the past season the work of the United States Geological and Geographical Survey, under the direction of Prof. F. V. Hayden, was continued northward into portions of Wyoming and Montana Territories. The usual appropriation for the survey was not passed by Congress until July, rendering the field season very short, yet the results were of considerable magnitude and of much importance.

The survey proper was divided into four parties, one of which was devoted to the extension of the primary triangulation to the northward, two were engaged in topographic and geologic work, and the fourth performed photographic and special geologic duty. All the parties left the Union Pacific Railroad from Point of Rocks and Green River Stations about July 25, and proceeded northward toward the Yellowstone National Park. To the second division was assigned the duty of making an exhaustive survey of the park and its surroundings, and to the third the exploration of the Wind River range and the Snake River country. The primary triangulation was extended over about twelve thousand square miles. Eight primary stations were occupied, among them Wind River, Fremont's and Grand Teton Peaks, which are among the most difficult and hazardous of ascent on the continent. This division would have performed double this amount of work had

a band of hostile Indians not robbed it of its entire outfit about the middle of the season.

The second division made a very detailed survey of the National Park, securing the materials for the preparation of a topographical and geographical map on a scale of one mile to one inch. The geologist not only studied the geology minutely, but also sketched every square mile of the area. An unusually interesting and valuable collection of volcanic rocks and hot-spring specimens was obtained. The entire collection of the survey, which are of a varied character, will amount to about three tons weight.

The third division explored with equal care the Wind River and Teton ranges of mountains, a region of which comparatively little was previously known. The peak named by the survey Fremont's Peak was found to be over 14,000 feet in height above the sea, with no trace that any human being had ever previously reached its summit. Three complete glaciers were discovered on the east side of the Wind River Mountains, the first ever known to exist east of the Pacific coast. The old glaciated rocks and morainal deposits were found on a remarkably grand scale in both the Wind River and Teton ranges.

The object of again surveying the Yellowstone Park was to bring it under the system of triangulation which had been employed with so much success in Colorado and to make the entire work uniform. All the old hot-spring basins were resurveyed in great detail, and several new ones were discovered and mapped. Soundings and temperatures of several thousand hot springs were taken. The history and habits of the geysers were carefully studied. The photographer of the survey obtained over fifty fine views of the bowls and other curious ornamental details of the Hot Springs.

The results of the season's labors, though a short one, have been on the whole very satisfactory. About 12,000 square miles of very difficult country were surveyed, much of it in minute detail, and a mass of observation secured for the twelfth annual report, which will make it of more general interest and value than any of the preceding.

The district assigned to this survey by this department for the next Atlas comprises all the area of the Territories of the United States north of latitude 41° 45′, east of meridian 117° and west of meridian 94°. It is estimated that the mapping of this area will occupy five years more, and when this is completed, the survey will have mapped over one-fourth the territory of the United States west of the one hundredth meridian.

GEOGRAPHICAL NEWS.—Petermann's *Mittheilungen* will be continued and conducted by Dr. E. Behm, who has been long connected with Justus Perthes Establishment, is one of the editors of the well-known *Bevölkerung der Erde*, and is the author of the

excellent monthly summaries of geographical news in this most important of geographical journals. Besides others, the number for November contains an article on the use of elephants in African exploration, written by Dr. Petermann shortly before his death, and one concerning D'Alberti's New Guinea Exploration, with a map of the Fly River.——The *Geographical Magazine* for November contains the best map of the seat of war in Afghanistan which has yet appeared, both as regards accuracy, fullness of information and excellence in the mechanical execution. With the December number this periodical ceased to be published, but is replaced by the *Proceedings of the Royal Geographical Society and Monthly Geographical Record*, under the charge of the Secretary of the Society, Mr. Clements R. Markham, who so ably conducted the magazine.——Several new geographical monthly periodicals have recently appeared in Europe. The *Deutsche Rundschau für Geographie und Statistik* is edited by Prof. Arendts, of Munich, and published by Hartleben, Vienna. *Aus fernen Zonen*, published by Mutze, Leipzig, is especially intended for the reception of communications from members of the various Christian missions in the less known portions of the globe; whilst from Paris the *Annales de l'Extrême Orient*, edited by Count Meyners d'Estrey, of the Indian press, expects to keep the scientific world informed of literary and geographical progress in Southern Asia, and especially in the Dutch Indies and in Dutch Oriental literature.——Dr. Nachtigal, the distinguished African traveler, has been elected President of the Berlin Geographical Society.——The *Athenæum* states that Mr. Johnson, the present Governor of Ladakh, when connected with the Indian Survey of 1865, ascended Peak E. 61 of the Kuen Lun range, whose height it now appears is no less than 23,890 feet! This is believed to be the greatest height above the level of the sea attained by any traveler on foot. The plains at the base of the Peak have probably an altitude of nearly 18,000 feet.

MICROSCOPY.[1]

REMOVAL OF AIR FROM MICROSCOPIC SPECIMENS.—Much difficulty has been experienced by the working microscopist in removing air from his specimens. If he wishes to mount wood-sections the difficulty is increased. Some may suppose that such an undertaking is physically impossible; for hitherto, in spite of all the pains and labor taken, unless by some lucky stroke, as it were, bubbles of air will still be left in the objects, and the slide becomes entirely worthless as a perfect specimen.

Various methods have been adopted to remove these bubbles of air, with greater or less success. One method has been to soak the specimens, after they have been cut, in different fluids for some length of time. The favorite fluids have been turpen-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

tine, oil of cloves and the like; these, however, give very unsatisfactory results. My friend, Dr. C. B. Johnson, of Providence, R. I., informs me that he has sections of wood which have been laying in oil of cloves for over three years, and from which the bubbles of air have not been at all removed. Perhaps the same may be said of the oleo-resins. Recourse has also been had to the air-pump; the idea being that an object placed beneath the bell glass, a few strokes of the piston will suck out all the air from it. But although in theory this seems plausible enough, yet as a perfect vacuum cannot be attained, some air, be it ever so small an amount, must render the objects of no use for microscopic examinations.

Thus have microscopists been at their wits' end to discover some process by which their object can be perfectly and satisfactorily accomplished. As no notice has been made of late of any new procedure in this direction, I think my friend, Dr. Johnson, who has had great success in mounting objects for the microscope, can justly be entitled to the first discovery of a mode for the removal of air, at once simple and effective. The apparatus he employs is of very simple construction, being a digester, or, as in his case, a common dentists' vulcanizer, the means—steam. The specimens to be thus treated, especially those of wood, are prepared in the usual way, and made ready for mounting. They are next placed in a small vessel of any material which will resist a certain amount of heat. Dr. Johnson uses a small glass phial in his experiments; this is filled up with water after all the specimens, as many as it can conveniently hold, are placed within. A cork can be used, but a slit must be cut in it to allow the escape of air and the admission of steam and hot water. A little water is now poured into the vulcanizer, the bottle of objects placed within and the lid of the machine screwed air tight. The whole is now heated to a temperature of about 300° Fahr. for a few minutes. This temperature is sufficient for all practical purposes; a higher degree of heat is unnecessary, or a longer time to remain at the given temperature needless.

When sufficiently cooled the phial is removed, the water drained from the bottle and alcohol substituted. The specimens are now ready for mounting, or can be bottled and set away indefinitely for use.

This constitutes the whole process; by it the specimens are *absolutely free* from air. Perfect satisfaction is guaranteed; and in every case we are absolutely sure of the results, provided of course that the proper care has been taken.

The *modus operandi* seems to be that the steam penetrates the pores of the wood or other substances, and forces out the air whose place it takes. The air is then absorbed by or dissolved in the surrounding medium. The woody fibres are not destroyed by the hot and compressed steam, except the soft tissues, as one would at first

sight suppose. They are entirely uninjured, and their purposes for microscopic study remain as good as by any other process. Tender specimens in every case must be tenderly treated. This mode of procedure has been followed by several microscopic friends in my vicinity for two or three years, and all the specimens so treated have been remarked for their beauty and excellence.—*F. C. Clark, Providence R. I.*

LIMITS OF ACCURACY IN MEASUREMENTS WITH THE MICROSCOPE.—Before we can safely draw conclusions from a given series of measurements, it is necessary to know within what limits their errors can be determined. A simple and direct way to do this is to compare the measurements of the same space made by different observers and under entirely different conditions. I may get results which show an agreement, *inter se*, quite within the limits of the accuracy required, and which are yet wide of the truth. But if another observer obtains substantially the same results from a series of measurements made under entirely different conditions, the inference of their general correctness may be drawn with tolerable safety.

One must draw a sharp distinction between absolute accuracy and an appearance of accuracy. For example, the head of the screw of my dividing engine can be set to correspond to a motion of one billionth of an inch with entire certainty as far as the mechanical indications of this degree of accuracy are concerned, and yet previous to May, 1877, the actual errors of a given ruled plate amounted under certain conditions to $\frac{1}{7000}$ of an inch. Even now, after four epochs of improvement, I can hardly say of a given space that it is certainly true within $\frac{1}{50000}$ of an inch, until I have made a special investigation of it with my comparator.

In carrying forward this investigation I was fortunate in securing the coöperation of Prof. Edward W. Morley, of Hudson, Ohio, an observer who possesses in a high degree the three requisites, patience, care and skill. I ruled five plates of bands, plates No. 1 and No. 2, having spaces of $\frac{1}{5000}$ and $\frac{1}{2500}$ of an inch, respectively. These plates were ruled just as, I regret to say, all plates were ruled previous to May, 1877, without any attempt to correct the errors peculiar to the screw and its mounting. For four years previous to this date every effort was made to correct these errors by mechanical adjustments. After this date I deliberately abandoned all attempts to do this. Instead, I resolved to admit the existence of these errors, and after determining their value, I adopted a device for correcting them during the process of ruling. Plate No. 3 was ruled like No. 1, but with these systematic corrections applied. My next improvement consists in adopting a device for correcting not merely the systematic errors depending on one revolution of the screw, but also the errors peculiar to particular parts of the screw. Plate No. 4 consists of 101 lines separated by an interval of $\frac{1}{2400}$ of an inch, and freed as nearly as

possible from errors of all kinds. Plate No. 5 consists of 21 lines separated by an interval of $\frac{1}{20}$ mm. After careful measurement with two different micrometers and two comparators, the plates were sent to Prof. Morley, the details of whose measurements will be found in the forthcoming volume of the Proceedings of the American Academy of Arts and Sciences. The degree of agreement between his results and my own is much more perfect than I had anticipated before beginning this investigation.

From this investigation I think we may safely draw the following conclusions: (*a.*) Two equally skillful observers can measure the same space within about $\frac{1}{300000}$ of an inch if the space does not exceed $\frac{1}{500}$ of an inch. For a space of $\frac{1}{100}$ of an inch the deviation will probably amount to $\frac{1}{80000}$ of an inch in case the measurements are made with an eye piece or a filar micrometer. (*b*). The average deviation for accumulated errors under similar conditions is not far from $\frac{1}{50000}$ of an inch for eleven intervals. For a larger number of intervals the deviation will be somewhat larger, but it will not be in proportion to the number of intervals. (*c*). A single observer can obtain an agreement with a normal equation representing all the observed values as far as a solution by least squares can represent them, within somewhat smaller limits than those obtained by comparing the results obtained by two different observers.—*Wm. A. Rogers, Harvard College Observatory.* (*From a paper read at the National Microscopical Congress, August,* 1878.

THE SOCIETY SCREW.—At a recent meeting of the State Microscopical Society of Illinois, Mr. Bulloch urged the desirability of adopting a uniform objective screw of larger size than the society screw now in use, as being essential to the efficiency of low power lenses of high angle. That the society screw, which has now become an almost indispensable convenience, is too small to admit of efficient work from these lenses, is a conceded fact, and some makers in this country who make low powers of enormous angle have already adopted special screws for them. The uniformity urged by Mr. Bulloch is greatly to be desired, and could be easily attained if its importance were appreciated in time.

EXCHANGES.—Gatherings containing polycystina, etc., wanted in exchange. Address I. F. Stidham, Columbus, Ohio.

Western mosses, etc., for other species. George W. Worcester, West Side, Crawford Co., Ohio.

Diatomaceous earths and named diatoms for named diatoms or other good mounted objects. M. A. Booth, Longmeadow, Mass.

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SCIENTIFIC NEWS.

— The United States Entomological Commission, attached to the United States Geological and Geographical Survey of the

Territories, has issued its first report on the Rocky Mountain locust, or destructive grasshopper of the West, a volume of 700 pages, fully illustrated with maps, plates, and woodcuts.

The favorable predictions made by the commission last winter had an encouraging effect, and stimulated the immigration to the country of late years ravaged by locusts. The statement which a full survey of the field enabled the commission to make in advance, viz: that there would be no serious injury in 1878, has been fully verified. The commissioners have continued their labors during the past summer, confining their attention to that northwestern portion of the country which they have designated as the Permanent Region, the object being to gather further knowledge of that region, with a view of preventing the ravages of the Rocky Mountain locust therein and its migration therefrom.

The problem of destroying the young insects as they hatch out in the more fertile country in the agricultural regions of the West, is virtually solved in the report which the commission has already issued, and the task which they now undertake is to endeavor to prevent the migration of the winged insects from the Permanent Region into the more thickly settled country.

An appropriation of $25,000 was asked of the last Congress for the completion of the work mapped out, and $10,000 were appropriated, and this only toward the end of the fiscal year. The commissioners ask for an additional sum of $15,000, in order that they may be able to continue their investigation until the practical work is accomplished. It was too late in the season when the last appropriation was obtained to permit the completion of the work this year, but with such means as they have husbanded, added to the additional appropriation asked for, and with promised assistance by the Dominion authorities, they will be enabled, by getting into the field early the coming spring, to complete fully the work assigned to them.—*From the Report of the Secretary of the Interior for* 1878.

— A report of the Chesapeake Zoölogical Laboratory for the last summer appears in the Third Annual Report of the John Hopkins University, Baltimore. This laboratory was established by Prof. W. K. Brooks for the higher instruction of the students of the University and others in zoölogy. It was opened at Fort Wool, June 24, 1878, and closed Aug. 19th. Some excellent work was accomplished, notwithstanding the lack of the large marine animals. Enough was accomplished, we should judge, to warrant the authorities of the University in maintaining the school and rendering attendance upon it a necessary part of the biological course.

We notice that the following papers in biology were read at the meetings of the Scientific Association of the John Hopkins University: On the early stages in the development of Gastropods,

by W. K. Brooks; A review on the expenditure of energy by working muscle, by H. N. Martin; On the formation of the female pelvis, by C. Sihler; On the influence of stimulation of the optic lobes upon the respiratory center of the frog, by H. N. Martin; Contributions towards a history of the Maryland Cambari, by P. R. Uhler; The Urodela of North America, by S. F. Clark.

— The work of the United States Fish Commission was carried on with an unusual degree of success at Gloucester, Mass., during the past summer. The steamer *Speedwell* made her last trip September 26th, having been used almost daily in dredging trips since the middle of July. Prof. Baird, the commissioner, was assisted by Professor Verrill, Mr. Richard Rathbun and Mr. Sanderson Smith, who paid special attention to the marine invertebrates; Prof. Farlow studied the algæ, Prof. Goode, Dr. Bean and Mr. Earle attended to the fishes, while Mr. Asaph Hall, Jr., had charge of the temperature observations. A good many new fishes, corals and other invertebrates were collected, while much that is new regarding food-fishes and fisheries was discovered. The energy and success of the manifold operations of this important Commission are most apparent.

— A goose belonging to a Gloucester, Mass., family died last week at the advanced age of 70 years. They have another still living that is known to be 50 years of age.

We have not endeavored to substantiate this statement, but copy it from the daily papers. Geese of this age certainly deserve an obituary notice. Can any one give us authentic statements regarding the extreme old age of fowl and quadrupeds?

— We learn from Mr. S. H. Scudder that a hymenopterous insect (Myrmar) very slightly larger than *Pteratomus putnamii*, being very slightly over one-ninetieth of an inch long, has been found in amber, according to Duisberg's Zur Bernstein Fauna (Schriften K. Phys. Okonomische Gesellschaft zu Königsberg. Band 9, p. 23). These two insects are members of the same family (*Proctotrupidæ*) and are the smallest insects yet known.

— B Westermann & Co. send us the title of an important work whose publication has just begun, viz: Buctecker's Systema Entomologiæ sistens Insectorum Classes, Genera, Species. Pars I. Odonata (Fabric.) Europ. 42 tabulæ, photograph. floridisque coloribus distinctæ. Colored $27.50, plain $13.20 This work will be published in fifteen volumes, and its continuation is secured, the MS. being all ready.

— We have been repeatedly asked what is the figure on the first page of the cover of this magazine. It is copied from a figure in Haeckel's great work on Radiolaria, of his *Eucyrtidium cran-*

oides. The bell-shaped shell is perforated by numerous holes, out of which stream in all directions the pseudopodia, some of which are enlarged at intervals into small masses of protoplasm.

— The death has recently been announced of Sir Richard John Griffith, Bart., the geologist and engineer, who died in Dublin, aged 94 years; of Thomas Belt, an English mining engineer and geologist, well known from his "Naturalist in Nicaragua," who died at Denver, Colorado, Sept. 22d; and of Prof. Robert Harkness, who died Oct. 3d, at Dublin.

— Subscriptions are solicited for a Manual of Conchology; structural and systematic, with illustrations of the species, by George W. Tryon, Jr., conservator of conchological section of the Academy of Natural Sciences, of Philadelphia. Vol. i, Cephalopoda, will be published by the author at Philadelphia, during the the coming year.

— The schooner *Florence*, of the Howgate Arctic Expedition, which returned at the close of October, Congress having failed to appropriate money for Polar colonization, brought home valuable collections of specimens and drawings, made by Mr. Kumlein, the naturalist of the expedition.

— Under the name of *Science News*, Mr. S. E. Cassino, of Salem, Mass., publishes an octavo fortnightly magazine of sixteen pages, edited by Messrs. Ernest Ingersoll and W. C. Wyckoff. It is devoted to general science, physical as well as natural.

Dr. Kalter, the editor of the *Entomologische Nachrichten*, published fortnightly at Putbus a Rügen, Germany, desires copies of papers and articles by North American entomologists for notice in his periodical.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Nov. 5, 1878.—Thos. Meehan and others remarked upon the indigenous character of *Calluna vulgaris*.

Nov. 12.—Dr. Jos. Leidy made some remarks on the distribution of *Chenopodium*; he also described some parasites of *Donax fossor*, one of which he named *Distomum cornutifrons*. Meehan remarked on *Mitchella repens*. Dr. A. J. Parker made some remarks on the comparative development of the Island of Reil in the brains of Primates.

Nov. 19.—Messrs. Gray, Redfield and Meehan spoke on the evidence in favor of the indigenous character of *Calluna vulgaris*. Drs. Leidy and Evarts made observations upon Gordius, the former gentleman describing a new species parasitic in *Clepsine* which he called *G. tenuis*.

Dec. 3.—Dr. Leidy made some remarks on the rarity of *Taenia*

solium, and the commoner occurrence of *T. mediocanellata*, with some account of the specific differences which he had observed.

Proceedings of the Sections of the Academy:—Microscopical and Biological, Nov. 4.—Mr. J. A. Ryder remarked "On the Gemmule vs. the Plastidule as the Ultimate Physical Unit of Living Matter."

Nov. 18.—Dr. J. G. Hunt, on the classification of Fungi and the best modes for their microscopical study. Mr. Jos. Zentmayer exhibited a new mechanical revolving stage, which admitted of 70° of obliquity of illumination.

Dec. 2.—Dr. H. C. McCook made a communication "On the minute anatomy of the stinging organs of ants."

Boston Society of Natural History, Nov. 20.—Dr. David Hunt make a communication entitled Darwinism and the Human Eye; Dr. C. S. Minot remarked on growth as a function of cells.

Dec. 4.—Dr. S. Kneeland remarked on traces of the Mediterranean nations in the Northern Ocean. Mr. S. H. Scudder read a paper on early types of insects, or the origin and succession of insect life in palæozoic times.

American Geographical Society, Dec. 12.—Mr. James Douglas, Jr., gave an account of his journey along the West Coast of South America from Panama to Valparaiso.

Appalachian Mountain Club —Prof. H. F. Walling gave some account of Mt. Toby, Mass., and Mr. W. H. Pickering described an ascent of the Half Dome, Yosemite.

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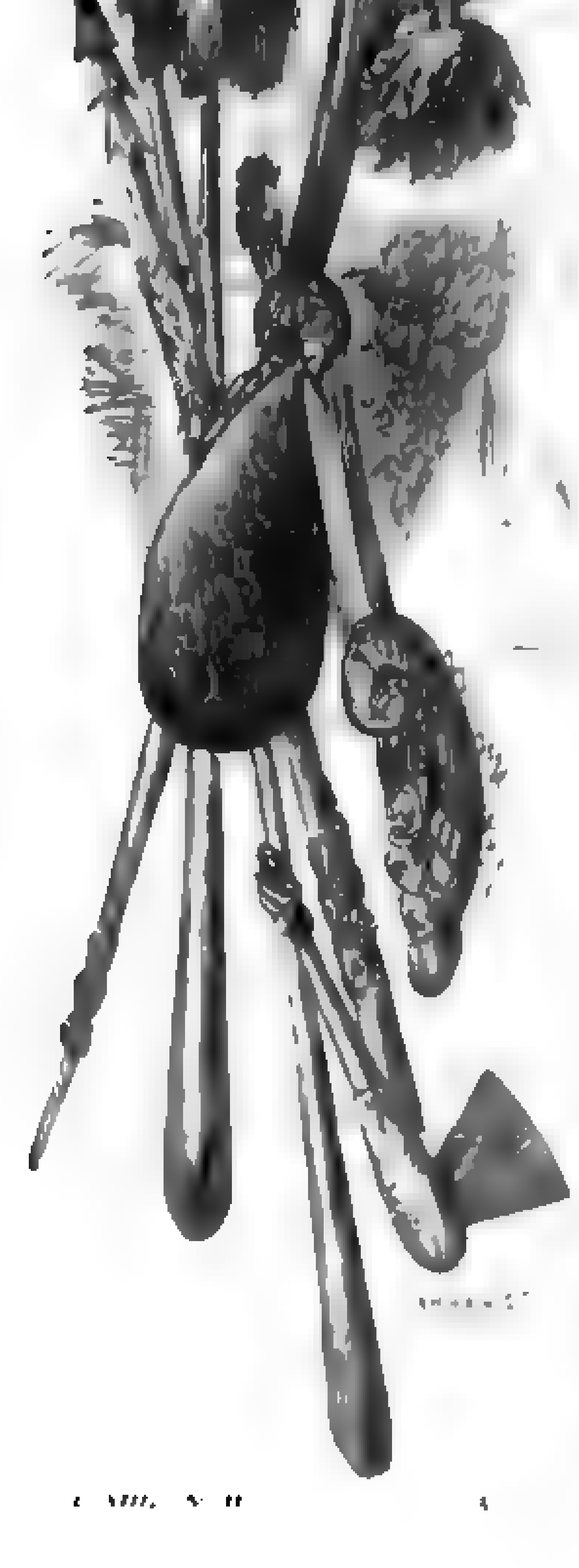
SELECTED ARTICLES IN SCIENTIFIC JOURNALS.

American Journal of Science and Arts.—December, 1878. Valley of the Minnesota river and of the Mississippi river to the junction of the Ohio: its origin considered, by G. K. Warren (with eight plates). On some points in lithology, J. D. Dana. Anatomical peculiarity by which crania of the Mound-builders may be distinguished from those of the modern Indians, by W. J. McGee. Discoveries in western caves, by H. C. Hovey.

Siebold and Kolliker's Zeitschrift für wissenschaftliche Zoologie.—November 11. On the convolutions of the brain of the Ungulates, by J. Krug. Contributions to the anatomy of the Ophiurans, by Prof. H. Ludwig. On some cases of parasitism in the Infusoria, by J. Van Rees. On the developmental history of the fresh-water mussels, by C. Schierholz.

Annales des Sciences Naturelles.—August 5. Anatomical and physiological researches on respiration in the fishes, by M. Jobert. Experiments on the conditions of development of Ligulæ, by M. Deschamp.



THE

AMERICAN NATURALIST

Vol. XIII.—FEBRUARY, 1879.—No. 2.

A SKETCH OF NEW ZEALAND,

WITH PEN AND PENCIL.

BY I. C. RUSSELL.

LET us turn our attention briefly from the historic lands of Europe and the East, to the wild and beautiful islands in the southern hemisphere. To a mind well stored with the poetry and art of ancient civilizations, such a change will open out new paths for thought amid scenes of rare beauty and grandeur. Of all the islands which, like great emeralds, stud the southern seas, none

have greater natural attractions than New Zealand. As but few Americans have visited those distant shores, we venture to offer the following notes, which we have gleaned not only from the writings of others, but also from personal observations while residing in those islands and from conversation with colonial and aboriginal inhabitants.

Like Van Diemans Land, now changed to Tasmania, New Zealand is unfortunate in its name, as it is in every way in contrast with the Zealand of the Netherlands; while the latter is nearly as level and uniform as the sea, the former possesses some of the wildest and grandest scenery in the world.

We owe the discovery of these islands to the Dutch navigator Tasman, who, in December, 1642, then on his great voyage of

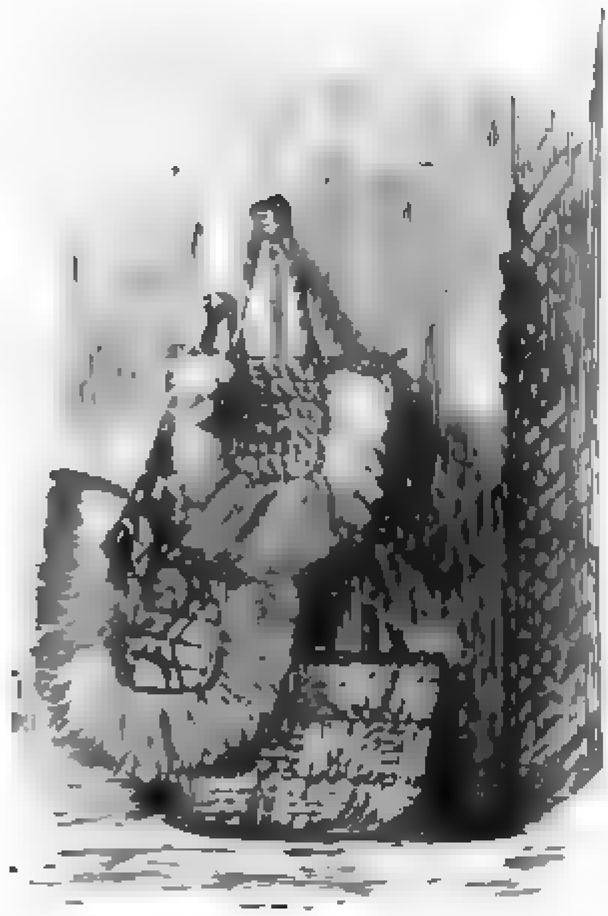
Storehouses.

discovery in the southern hemisphere, came in sight of a bold mountainous land wreathed in clouds, which had never before been seen by Europeans. He relates in the narrative of his voyage that upon sending a boat to this unknown shore, it was furiously attacked by the natives who thronged the beach, and three of his sailors killed. This bloody introduction, together with the knowledge which was soon gained, that the New Zealanders were cannibals, at once stamped that race in the sight of all civilized people as a most fierce and cruel one.

This land was next visited, in 1769, by Captain Cook, who,

during his three voyages to the southern seas, very fully explored and surveyed its coast. Passing through the strait that now bears his name, Capt. Cook showed that New Zealand was composed of two main islands; he also found associated with these a number of smaller and far less important ones. These are now looked upon as forming a distinct archipelago, which is not only isolated from the rest of the world by its geographical position, but in the peculiar character of its native inhabitants, and in the nature of its fauna and flora.

The two main islands extend from the 34° of south latitude 800 miles to the southward, and have an area of about 120,000 square miles, or a little more than the size of Italy. These two countries have, also, a somewhat similar boot-shaped form, the toe in each case being turned towards the equator. These islands are known as the North and South Islands; or in the more poetic language of the aborigines, as *Te Ika a Maui*—the fish of Maui—referring to the form of the North Island; and *Te Wahi Punamu*—the place of the greenstone — indicating the locality that afforded the highly-prized nephrite from which the aborigines shaped their stone implements and personal ornaments. The place of the "punamu" plays as important a part in the history and traditions of the New Zealanders, as did the celebrated red pipe-stone quarry of Minnesota among the red races of America.



Bags made of Phormium leaf, or New Zealand bag.

The North Island is mainly interesting for its lofty volcanic mountains and the indications of volcanic activity still exhibited by the smoking volcanoes, solfataras and hot springs which form the most striking features in its scenery. Among the numerous mountains that record the energy of the ancient volcanic erup-

tions, the most remarkable are Mts. Egmont and Ruapeau, together with the still smoking peak of Tongario. The latter rises near the center of the island to an elevation of 6500 feet, and is the sacred "tapu," mountain of the natives, which no one is allowed to ascend. The trachytic mountain, known as Ruapeau, is the near neighbor of Tongario, and is the highest point in the North Island, its summit being 9165 feet above the sea, and about a thousand feet above the line of perpetual snow. According to the traditions of the Maoris, these mountains once had another neighbor whom they called Taranaki, a quarrel having arisen among them concern-Pihanga, the wife of Tongario, Taranaki was forced to flee to the westward as far as the sea, and now forms the grand Mt. Egmont, whose snowy summit is a beacon to the far off mariner.

Maori Woman.

Northward of the central volcanic region is the beautiful Lake Topu, about twenty-five miles in length, which is especially interesting for the numerous hot-springs and geysers along its shores, and also for its charming scenery, the grand summits of Tongario and Ruapeau limiting the view to the southward. Between Tongario and White island, in the Bay of Plenty, the only active volcanoes in New Zealand, lies the wonderful "Lake District," that is so widely known for the extent and beauty of its spouting geysers, mud-volcanoes, etc. The heated waters of these springs bring with them large quantities of silica which is deposited around them in a series of beautiful siliceous basins, which are ornamented, as if by fairy art, with the most delicate tints and tracery;

from one to another of these snowy basins flow the clear bluish waters of the fountains. All these indications of the expiring volcanic energy that has been for a long time active, combine to make the Lake District one of the most remarkable places in New Zealand, and equal in interest to the geysers of Iceland, or to the wonderful region of the Yellowstone.

Another area of former volcanic activity, is the peninsula of Auckland, forming the northern extremity of the island. This region is occupied throughout by a great number of volcanic cones, all of which are now extinct and are less remarkable for their size than for their regularity and beauty. Many of these cones of eruption are surrounded from bottom to top with a series of artificial terraces, which, a few years ago, supported palisades and formed the feudal castles of the aborigines.

Maori Man.

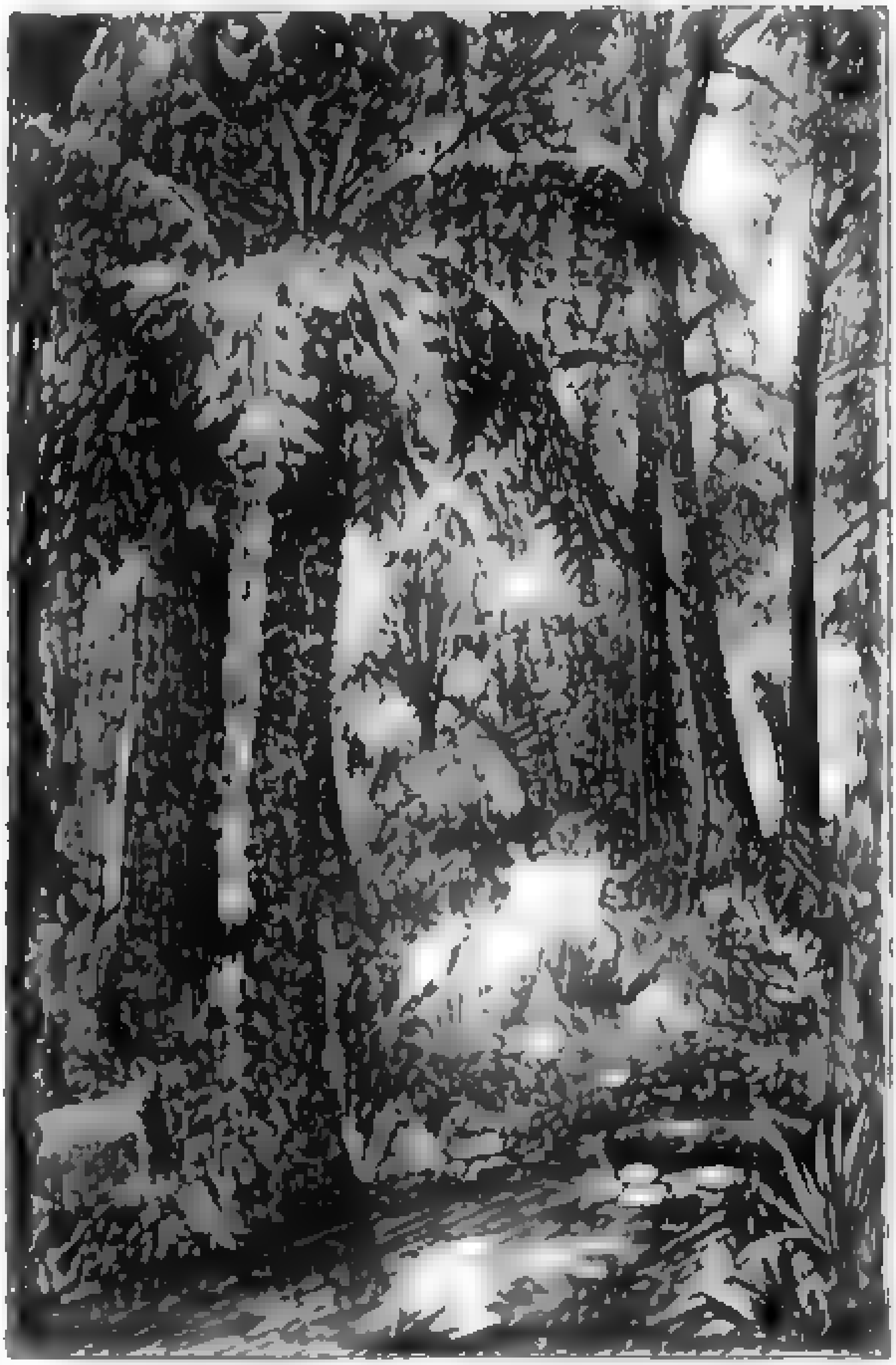
The South Island is traversed throughout its whole extent by a great chain of rugged mountains, which were very justly named the Southern Alps. These lofty snow-clad summits give to the South Island a grandeur of scenery peculiarly its own. Midway down the west coast stand the giant peaks of this island; of these Mt. Cook is the highest, and attains an elevation of 13,200 feet. Mt. Cook and its host of sister mountains, all robed in eternal snow, combine to form the grandest mountain scenery in New Zealand, if not in the world The snow-line is sharply drawn along the sides of these rugged mountains at an elevation of about 8000 feet. Above this height the snows and frozen mists accumulate, and form vast snow-fields which give

rise to the numerous glaciers that flow down from the Southern Alps. The largest of these ice-streams yet explored is the Great Tasman Glacier. This flowing river of solid ice has its source on Mt. Cook and the neighboring peaks, and flows for a distance of eighteen miles down the valley, bearing on its surface an immense load of débris which is slowly carried downwards and at last deposited at the extremity of the glacier as a terminal moraine. This immense glacier ends abruptly in a wall of ice, stretching across the valley one hundred and twenty feet high and nearly two miles in length. Another of the numerous glaciers of the South Island which has attracted considerable attention from the low position it attains before becoming melted by the warm air and winds in the lower portion of the valley, is the Francis Joseph Glacier. This ice-stream flows towards the west coast, and reaches to within about 700 feet of the sea level.

Far below the present glaciers are found the records left by still greater streams of ice, that in times long past descended from the same mountains. Sometimes a hundred miles beyond the terminus of the existing glaciers, an immense wall of glacier-worn boulders and other débris is found, stretching completely across the valley. These huge moraines mark the place where an ancient glacier terminated, and for many centuries deposited, as a terminal moraine, the stones and rubbish that accumulated on the surface of the ice, and were carried slowly forward as lateral and medial moraines.

To the eastward the mountains slope gradually to the ocean, and are bordered by the Plains of Canterbury and other rich areas. On the westward they come boldly down to the sea, and are penetrated by many picturesque sounds and fiords that extend far into the heart of the mountains. Corresponding to the bays and sounds that fringe the west coast, we find to the eastward of the mountains many beautiful lakes which fill deep Alpine valleys and render back the grandeur of the snowy giants that surround them. Lake Wakatipu, which is the largest of these, extends for a distance of seventy miles into the Southern Alps, and seems like a great placid river winding down through the mountains. In the grandeur of its scenery this lake is unsurpassed by the most celebrated lakes of Switzerland or Scandinavia. Lake Wanaka, to the northward of Lake Wakatipu, is pronounced by all travelers who have visited it, to be "the most beautiful lake in *all the world.*"

Since New Zealand was made an English colony, in 1840, great numbers of Europeans have emigrated to her shores. These colonists carried with them the energy and civilization of their native land, and at once became actively engaged in commerce,



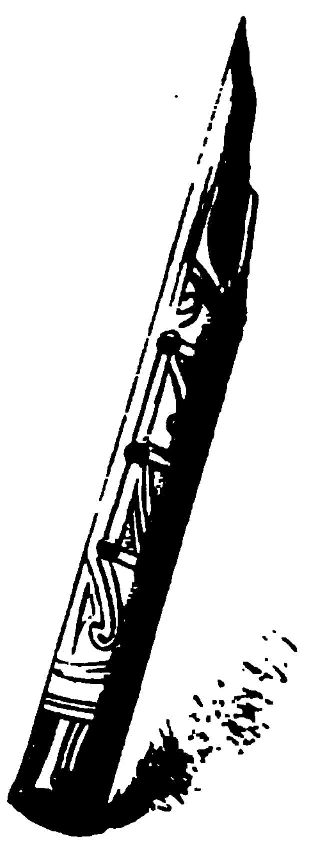
New Zealand Forest

agriculture, mining and other industries. The contrast between the thriving colony of to-day and the luxuriant wilderness described by early travelers is very striking. It almost seems as if some magician had waved his enchanted wand over those distant islands and caused populous and beautiful cities to appear where before only rank ferns grew.

The early voyagers to New Zealand found the land inhabited by an offshoot of the widely scattered Polynesian family. These *aborigines* still retained the stamp of the brown race from which

they sprang, were of good physique, having regular and often handsome features, and with long dark hair, indicating their superiority to the black races of Africa.

These isolated people were still using implements of stone fashioned into the desired form by chipping and grinding, and frequently finished with a fine polish or covered with fanciful carvings. The material that was often used, not only for stone-axes and war clubs but also for long ear-rings and other personal ornaments, was the celebrated punamu, or green jade from the western shore of the South Island. Many of the stone instruments in the hands of the New Zealanders remind one forcibly of the similar implements used by the Lake-dwellers of Europe, and the stone axes, adzes, etc., from the ancient mounds of our own country Like the Neolithic men of Europe, the New Zealanders had their fish-hooks of bone and their personal ornaments of shell and stone. As is common with uncivilized people, they amused themselves in carying on bone—frequently of slain enemies—and on stone and wood. Many of these elaborate carvings are elegant in design and were beautifully executed with no other instruments than those of stone. Their desire for ornament was so great that they covered their features with tattooing, transferring indelibly to their faces complicated patterns of curved and spiral lines, similar to the designs with which they decorated their canoes and houses.


Maori Nose Flute.

These aborigines were well advanced in all the arts that pertain to barbarous life. They lived in well built houses, usually grouped in villages, or "pahs," and surrounded by strong palisades; these, if well garrisoned, were impregnable until the introduction of fire-arms by the Europeans. The incessant warfare that was carried on between the various tribes was exceedingly fierce and bloody. From the nature of their arms the battles were usually hand-to-hand encounters. The wars were entered into not only from motives of self protection or revenge, but also to obtain slaves and human flesh for the sustenance of the victorious tribe. As may be imagined, such a state of things did much towards keeping the population scanty and the various *tribes widely* separated.

These aborigines, Maoris, as they termed themselves, were without any form of worship, their nearest approach to a religion being the exaggerated myths and fables of their ancestors. They stand among the very first of uncivilized races, not yielding in personal vigor or bravery to the best of the North American Indians, and unlike them possessing a mind remarkably plastic and capable of improvement and Christian civilization. Such

Lake Wakatipu

were the people of New Zealand before the pale-faces came among them; since that time their destiny has changed. Although they have abandoned the practice of cannibalism and ceased the fierce wars among themselves, yet they have met a new element in the struggle for existence that is more potent than either. The very presence of the white man seem to affect these children of nature like a deadly malaria. The Maoris, themselves, are aware of their destiny and say, "as the clover killed the fern, and the European dog the Maori dog; as the Maori rat was destroyed by the Pakeha rat, so our people also will be gradually supplanted and exterminated by the Europeans." According to Dieffenbach's calculations the native population of New Zealand was, at one time, about 115,000, in 1872 it had decreased to a little more than 45,000. The natives that remain are every day departing farther and farther from the customs and traditions of their ancestors. Many of the arts that occupied the people in former days are now forgotten; they no longer shape and polish implements of stone, or weave blankets and mats of Phormium. The

"moco" or tattoo that in former days was characteristic of the people, is now seen only on the older faces; the younger generations having abandoned the custom through the influence of the missionaries.

• The Chief's Son.

Not only has New Zealand presented us with a new and extremely interesting picture of man yet in the stone age, but its flora and fauna have been found to be equally instructive.

The traveler who enters for the first time a New Zealand forest, no matter from what land he may have wandered, will find everything new and strange to him. What especially attracts the attention is the great profusion of cryptogamous or flowerless plants, in which these islands are richer than any other country in the world. The ferns alone number about a hundred and twenty species, and form the the most characteristic feature in the landscape. Thousands of these beautiful plants cover the ground with their low and delicate fronds, as in some portions of our own country; others entwine the trunks of trees for support; still others attain the size of forest trees and rear their great crowns of feathery fronds to a height of forty or fifty feet in the air, rivaling in their grace and elegance the date-palm of Arabia. As there are but a few birds of song in New Zealand, and a scarcity of insect life, the woods are always silent. This, together with the strange weird forms of the vegetation around, makes a deep impression on the visitor to whom such scenes are new. Despite the luxuriance of the ferns, we miss the numerous sweet flowers that in our own minds are so closely associated with the deep shade of the forest. In New Zealand the blossoms are, for the most part, small and inconspicuous, and lacking in sweetness.

We would not have our readers conclude, however, that New Zealand is covered by one immense jungle of luxuriant vegetation. Although this is true enough of the regions near the coast, yet in the interior, especially of the South Island, the country assumes a bold and barren appearance, the rounded hills

Tree Ferns of New Zealand

having scarcely any vegetation except the brownish bunch-grass and clumps of Pteris. Still farther inland the scenery becomes wild and Alpine in the extreme. The cause of this great contrast in the aspect of the country lies not only in the elevation above the sea, but also in the peculiar physical features of the land. The high snow-clad mountains that border the western

shore of the island rob the prevailing westerly winds of their moisture, so that when they sweep on over the land to the eastward, they have but little of this life-giving element to part with.

The fauna of New Zealand, like its flora and scenery, is especially peculiar to itself. The first feature that attracts our attention is the almost total lack of land mammals and reptiles. The former are represented by two species of bats and the latter by a few small lizards. The position filled by the mammalia in other countries is there occupied by the feathered tribes. The birds having been, for a long time, almost the sole dwellers on the island, their development was carried on unchecked and unmodified by many of the circumstances that influence their existence in other countries. This freedom of development resulted in the production of many strange and anomalous forms that were unknown and unlooked for until the studies of the naturalist had confirmed the tales told by sailors and adventurers who had visited those distant shores.

One of the strangest birds in existence is the *Apteryx*, which, as the name signifies, is without wings. This bird is found only in New Zealand, and thus far only four species are known, mostly from the west coast of the South Island. These wingless birds are of great interest, not only from the strangeness of their structure and habits, but also for the information they afford in reference to the giant birds that at no distant day inhabited the same island, but which are now extinct. We refer to the huge Moa, whose bones are scattered over the country, often lying exposed beneath the thick groves of fern, and also occuring plentifully in caves and in recent river deposits. That these extinct birds far surpassed in size and strength any members of the feathered tribes now living, is shown by their ponderous bones which exceed even the bones of horses and oxen in size. Some of the tibias of these birds measured three feet in length, the femur that once articulated with it being between seven and eight inches in least circumference. The largest of these birds, when alive, must have stood at least ten feet high, as is unquestionably shown by some of the complete skeletons which have been mounted. There were surely giants in the days when these monsters strode along in the shadows of the tree-ferns, or tore up the roots of the Pteris with their powerful claws. That the Moa lived in New Zealand after the settlement of those islands by the aboriginal inhabitants is shown by the remains of these birds, which have been found

mingled with the charred bones of men and dogs, in the ancient ovens — "kitchen-middens" — which have been recently discovered. The natives now living know nothing of these strange birds except the existence of their bones in the caves, etc. In their old traditions, however, which have been handed down through many generations, references to the Moa are found, containing instructions to the young hunter how to ensnare and slay them.

In our wonder at the strangeness of these ancient creatures, we must not overlook the many smaller but extremely interesting birds now living in New Zealand. Many of these exhibit a tendency towards the wingless condition that formed such a characteristic feature in the ancient fauna. Among the numerous parrots, one large green species, called by the natives the Kakopo, attracts our attention in this connection, as the muscles of its wings are but poorly developed and useless for flight. The rails also afford two or three species that are incapable of flight. One of these the Wika, or wood-hen, is very common about the swamps and fern thickets. Another is the rare *Notornis*, of which but two individuals are known. The Pukeko is another of the rails that shows by the short, rounded form of its wings a tendency towards the apterous condition. Besides these more curious and interesting birds, New Zealand possesses a considerable variety of smaller and often very beautiful species, few of them, however, of remarkable for the sweetness of their song. Among these the Tui, or "parson bird" is one of the most interesting; its trivial name has reference to the two tufts of white feathers on the throat, which resemble the tie of the parson. The crooked-bill plover, which inhabits the North Island, furnishes the only instance known of a bird with its bill turned to one side; what useful purpose this strange curvature of the bill can serve is unknown.

Since the colonization of New Zealand, a great number of plants and animals have been introduced from other countries; many of these have found in those islands a congenial home, and often seem better adapted to the surrounding conditions than some of the native species, which they are fast displacing. Much of the fauna and flora that is now so characteristic of New Zealand is destined, like the Maoris themselves, to become exterminated by the advance of European civilization.

NOTES ON THE MANUFACTURE OF POTTERY AMONG SAVAGE RACES.[1]

BY CH. FRED. HARTT, A.M., LATE CHIEF OF THE GEOLOGICAL COMMISSION OF BRAZIL.

IN making a critical study of the Indian pottery of Brazil, both ancient and modern, I have been led to investigate some facts in connection with the methods employed in primitive ceramic art, which, up to the present time, have received but little attention.

Some of the more important of the conclusions reached by a study of ceramic ornament have been already briefly sketched in a paper on "Evolution in Ornament" (*Pop. Sc. Monthly*, January, 1875), in which I have attempted to show the origin and function of Decorative Art, and describe some of the more important steps in the growth of these ornamental borders so common on pottery, and known as frets, scrolls and honey-suckle patterns.

The use of pottery is unknown to many savage peoples, as for instance to the Esquimaux, the northern Indians of North America, the Botocudos and Cayapós of Brazil,[2] the Pampean races, the Fuegians, the Veddahs of Ceylon, the Andaman Islanders, the Australians, the Maoris and the Polynesian islanders generally. In some cases this ignorance of the art may be accounted for by the exceedingly low degree of culture of the tribe, as among the Botocudos. In Greenland we should scarcely expect the manufacture of earthenware to flourish, and its absence among the Greenlanders is compatible with a considerable advance in other arts.

Among the Algonkin tribes of Canada and the North-eastern United States, cooking is often done in vessels of bark, either by placing the vessel over the fire or by putting hot stones in the liquid (Relation de la Nouv. France, 1633, p. 4).

I have seen the Micmac Indians of Nova Scotia make square

[1] The following article, published at the office of the *South American Mail*, in Rio Janeiro, in 1875, assumes an intensified interest from the sad death of its author, even before his scientific career can be said to have fully begun. A few introductory and non-relevant sentences, and long quotations are necessarily omitted.—*O. T. M.*

[2] Among the Indians included in the great family of the Cayapós by Dr. Couto de Magalhaes, may be mentioned the Gradahús, the Gurutirés of the Xingú, the Cacahós of the sertœs of Maranhão, and the Cayapós of Matto Grosso.

or oblong vessels of the extremely thin, paper-like bark of the birch (*Betula papyracea* Ait.) and cook in them directly over the fire, just as water may be boiled in a paper cup. The Kutchin tribes of the MacKenzie river have no pottery, but they make kettles of tamarack roots, woven together very tightly and neatly, and ornamented with dyed porcupine quills, in which vessels they boil water with hot stones (Jones Smith's Report, pp. 66, 321).

The Indians of Santa Catalina, in California "brought fresh water to the Spaniards in flaskets made of rushes" (Burney, 2d Voy. of Sebastian Vizcaino, So. Sea Described, p. 248). Similar vessels are still in use in the same region, and Major Powell brought home from the Colorado, water baskets lined inside with pitch. The Maués of the Amazonas use water-tight baskets, and so also do the Kaffirs. Wooden kettles for stone boiling are found among many tribes, both in America and elsewhere, and the inhabitants of Amboyna and Ternate cook in bamboos (Chardin, iv, pp. 171, 172; Receuil des voyages, &c., iii, 322.)

The possession of a material like birch bark may render pottery to a certain extent unnecessary, and thus retard its invention and adoption. The whole subject of cooking in wooden vessels and of stone boiling has been admirably discussed by Tylor. That the inhabitants of the coral islands of the Pacific should be without pottery is not wonderful. It is said, also, that there is no potters' clay in the Sandwich Islands.

Man is not the only animal that makes vessels of clay, but he is the only one that bakes them in the fire to make them durable. Other animals make nests of clay for their young, but primitive man makes earthenware vessels in which to hide away his dead. Man's most primitive vessel was his hand; but leaves, shells, bark, tough skins or shells of fruits, sections of bamboos, &c., were soon used, as by means of these he could not only dip up water, but also transport it from place to place. The same vessels must also have served for the preservation and transportation of articles of food, etc. The art of pottery has, doubtless, originated independently in many different nations, and many circumstances may have led to the employment of clay for the manufacture of vessels. At Unalashka, Capt. Cook (Voy. ii, 510) saw "vessels of a flat stone, with sides of clay not unlike a standing pye." Lyons says (Private Journal, p. 320) that the Esquimaux women have an ingenious method of making lamps and cooking-pots of

flat slabs of stone which they cement together with a composition of seal's blood applied warm, the vessel being held at the same time over the flame of a lamp, which dries the plaster to the hardness of stone, and in a note he adds, that "the cement is composed of seal's blood, of whitish clay and of dog's hair. The natives think that the hair of a female dog would spoil the composition and prevent its sticking." On the Lower Murray the natives line a hole in the ground with clay, and cook their food in it, and sometimes they coat wooden vessels and gourds with clay to prevent their being burned. Both these customs just described might lead to the invention of pottery.

The material of which pottery is made is clay. Ordinary clay consists of fine particles of more or less decomposed feldspar, mixed with a larger or smaller per centage of free silica, which last may exist, either as an impalpable powder, or as a more or less coarse sand.

Kaolinite, used in the manufacture of porcelain, is a silicate of alumina derived from the decomposition of feldspar, containing soda or potash, and it consists mainly of a mixture of silicate of alumina and free silica.

Pure clay will not make pottery, because of its tendency to shrink and crack in drying and baking. It must, therefore, be mixed with some substance to counteract this tendency. In the making of sundried bricks, the Egyptians found it necessary to mix the clay with straw.

In pottery, the substance added is called by the French a *dégraissant.* One of the best materials for this purpose is sand, or powdered silica in some form, especially if the ware is to be burned at a high temperature.

The Danish archæologists have shown that the clay of which the pottery of the Kjœkkenmœddings was made, was mixed with powdered granite, apparently obtained by heating the rock and plunging it into water. In Chiloë to-day, the natives obtain a *dégraissant* for pottery in the same way (Wagner *Chimie Industrielle.* Tom i, 555). In some kinds of earthenware manufactured in England and on the Continent, powdered flint is added to the clay, the flints being prepared by heating them red hot, then throwing them into water, and afterwards pulverizing them (Brogniart, Arts Cer. 1854, i, 71).

Sometimes a cement of pulverized pot-shreds or *terra-cotta* is

added in the manufacture of certain kinds, both among civilized and savage nations. In making, for metallurgical purposes, crucibles that are required to stand great heat and sudden changes of temperature, burnt clay, obtained by powdering old crucibles, is sometimes added to the raw clay to prevent cracking (Fonck. *Zeitschr.* f. Eth. ii. 1870, iv, 290, Ure's Dict. sub Pottery; Brogniart i, 72).

The ancient Indians of Pacoval, on the island of Marajo, used to mingle powdered pottery with the clay for their ware, and in the mass composing the walls of fractured specimens from Sr. Ferreira Penna, I have found quite large fragments still showing their painted surfaces.

In both North and South America, where the Indian pottery is rarely ever thoroughly burned, the clay is often mixed with broken shells. Mica enters frequently into the composition of pottery, and Dr. Berendt has informed me that in Yucatan, even wash gold was occasionally used. Gold is also found in the material composing the pottery of Palembang, in the East Indies (Jour. E. Ind. Archipelago, 1850, iv, 273).

Powdered coke or furnace cinders, graphite, amianthus (Brogniart, l. c. i, 74), and even sawdust are employed in some kinds of modern European pottery, and where a low heat is used in baking, the clay is sometimes mixed with powdered limestone. At a higher heat this latter would serve as a flux.

I am not aware that the Indians of North America ever mixed ashes with the clay, but the custom is very general in South America, where the ashes of the bark of several trees are employed. In Guiana the bark used is that of the Couepi tree, (*Couepia guianensis*) (Ferdinand Fermin, Description générale, &c., de Surinam, i, 61).

On the Amazons the clay intended for the manufacture of pottery is mixed with the ash of the *Caraipé* tree, (*Moquilea utilis* Hooker) (Benth. Martius, Flora Braziliensis, Fasc. xli, Pl. 8, f. 11; Wallace, Travels on the Amazon, &c., 484; Marryatt, "Pottery and Porcelain," 509; Bates, "Naturalist, &c." 225). The Carajás, Caraja-is, Chambioás, Chavaútes, Chereútes, and Guajajaras of the Araguaya, mix with the clay the ashes of certain *sipós*. I have seen the *Caraipé* bark prepared by stacking the fragments on end in a conical heap, and then burning them in the open air. The ash is very abundant and preserves the original form of the frag-

ments. Having been reduced to powder and sifted, it is thoroughly intermingled with clay, to which, when wet, it gives a dark plumbaginous look, but this color grows much lighter on burning. The use of the *Caraipé*, according to universal testimony, makes the ware better able to stand the fire. The Indians of Sariacu use the ash of a bark called *Apacarama*, perhaps the same as *Caraipé* (Smythe & Lowe, Nar. of a Journ. from Lima to Para. Lond., 1836, 210). The *Caraipé* bark contains an enormous percentage of silica, which separates as a fine white powder. It is to this siliceous powder that the ash, doubtless, owes its value as a *dégraissant*. In the Amazonian region is found a species of fresh-water sponge, called *Cauxi*, containing siliceous spicules, and whose ash is sometimes used to temper clay for pottery (De Souza, Lembrancas, etc. do Amazonas, 101). According to Semper (Der Stil. Band ii, 122) the use of these *dégraissants* and cements, besides destroying the homogeneity of the paste, furnish innumerable points of rest throughout the mass that reduce the fragility of the ware after burning, and the danger of cracking, whether through change of temperature or by shock. The coarser particles serve to break up and distribute the undulations by which the cracks are propagated, very much as a fracture in a pane of glass may be arrested by boring a hole at the extremity of the crack.

By the advent of Europeans, pottery in America was invariably made by hand, the potters wheel being unknown. In the province of Para, among the Indians, and to a considerable extent among the whites, as each family makes its own pottery, stores of this clay are often laid up.

The clay, mixed with *Cariapé*, is kneaded with the hands into a mass, which is then divided into a number of balls about as large as the first. The woman potter then furnishes herself with a board or mat, on which to build up the vessel, some flat object on which to roll out the clay, a vessel of water, and a fragment of a *cuia* or a shell to serve as a smoothing instrument. If the vessel is to have a flat bottom, she presses out upon the board a round flat piece of the required size and thickness. This takes the impress of the board or mat, and fragments of the bottoms of vessels from the ancient site of the "Bluff-Dwellers" at Taparinha, near Santarem, are often beautifully impressed by the mat on which they were formed. Indian women of Santarem sometimes seat

themselves on the ground holding a large ball of clay between the feet. On this the vessel is built up, the ball being afterwards cut off, leaving the bottom flat.

After the bottom is formed, a piece of clay is rolled under the hand into a long rope-like cylinder. This rope is then coiled round the edge of the bottom of the vessel, being flattened sideways by pinching with the fingers of the left hand, and caused to adhere to the bottom. On this, coil after coil is laid in like manner, each being flattened as before.

After a few have been added they are worked into shape with the fingers, which are occasionally moistened in water, and the irregularities produced by the coils are caused to disappear. The vessel is formed by the hand alone, and the surface is smoothed down by means of a bit of gourd or a shell, which is, from time to time, dipped in water. If the vessel be large, it is now set away in the shade for a while to dry a little, after which new coils are added as above, no other instrument being used except the hands and the gourd or shell, with which alone the vessel may receive not only an extremely regular form but also a very smooth surface. According to Dr. de Magalhaes, "the pottery of the Carajás, the Carajáis, Chambioás, Chavántes, Cheréntes, Guajajáras of the Araguáya river is always made by coiling, the surface being worked down by the hand and water, and the aid of a sort of spoon-like trowel made of bamboo." The coils are so worked together that from a simple inspection of the vessel it is impossible to determine how it was built up. I should never have suspected that the pottery of Pacoval had been made by coiling, were it not that I found the coils still ununited on the inner surface of the heads of idols. The coils still preserve the delicate imprints of the fingers of the artist (AM. NATURALIST, V. 1871).

In building up a vessel, care must be taken to allow it to harden as the process progresses, so as to avoid its settling by its own weight, as it is very likely to do, especially if the vessel be large. This settling, under the influence of gravity, is, however, likely to give rise to graceful curves, and it would be interesting to determine how far the beauty of outline of pottery may have resulted from the imitation of forms that originated in this way.

Handles and all prominent ornaments are added afterwards, being luted on. Sometimes the outside of the vessel is orna-

mented by applying thin strips of clay laid on in spirals, and other figures as among the Greeks and Romans.

The ancient Bluff-Dwellers were very fond of ornamenting their pottery in this way. The "apple-pie" border, made by impressing with the extremity of the finger, or by pinching up a line of elevations between the thumb and forefinger, was also in common use among the same Indians, and is still perpetuated on the modern pottery of the Amazonas. It was rarely used by the Indians of Pacoval.

In Amazonian pottery, ornaments are rarely impressed or stamped. I have observed on the Bluff-Dwellers' pottery, circles made with the end of a hollow stick. The Chambioás and Carajás of the Araguáya make wooden dies, with which to ornament their pottery, the Carajás using a sort of Maltese cross.

The surface of the vessel, after having been smoothed down, is often washed with a thin layer of pure, creamy clay, which appears to be sometimes burnished before cooking, producing a beautiful, hard and almost polished surface. The common ware of the civilized Indians of the province of Para is usually very plain and rarely ever painted, but that of the Upper Amazon is often most beautifully ornamented in several colors, with frets and borders, and other purely æsthetic forms, the absence of all attempt at representations of plant forms being remarkable. Edwards says that the colors are laid on this Amazon pottery with a brush made of the spine of a palm. The black color is made of the juice of *mandioca*.

The ancient pottery of Pacoval is often adorned with frets and scroll borders and other ornaments, drawn on a white ground with marvelous accuracy (AM. NATURALIST, V., 1871; *Pop. Sc. Monthly*, Jan., 1875).

Ornaments are sometimes scratched with a sharp point on the surface of modern Amazonian pottery, and, occasionally, ornaments are made consisting of a series of holes. The etching on the Pacoval pottery is exceedingly delicate. Sometimes the same pottery is decorated by first washing the surface with white clay, and then engraving so as to leave an ornament in relief. The instrument used seems to have been a tooth of a *paca*, or some other rodent. Some of the large burial vases are covered with ornaments of this kind, which must have required long and patient labor.

Before burning, the vessels are allowed to dry slowly in the shade, and afterwards in the sun. The burning requires much care, and is performed in different ways. Usually, they are set at a distance from the fire, and allowed to become heated gradually, without actual contact with the flame, after which they are surrounded by fire and thoroughly burned. Very often they are covered with a heap of *Caraipé* bark, which is set on fire. Sometimes, on the Amazonas, pottery is burned in an oven or in a hole in the ground. The Carajás and other tribes of the Araguaya burn their pottery in ovens made by hollowing out the nests of the white ant. The ware is introduced, another excavation is made below the fire, and still another in the top of the nest to serve as a chimney. The enormous earthern pans (*yapóna*) on which farina is cooked, and which are sometimes four or five feet across, require to be burned with great care, and their manufacture is usually entrusted only to women of much experience. Ordinarily the pottery of the Amazonas is not thoroughly cooked. That of the Bluff-Dwellers is particularly poor in this respect. While the vessel is still hot after burning, it often receives inside a coating of melted *jutahy-sica* resin, applied with a swab, but I am informed that before the vessel is used on the fire, this is first burned out. This resin is said to be obtained from the *Jutahy* tree of the Amazonas (*Hymenæa courbaril*): but it does not appear to be the product of the *Jutahy* alone.

At Brèves, on the Island of Marajó, there is made a kind of pottery which is first washed with white clay, and after burning, painted in water color in the most gaudy and outrageous fashion. Over this color a varnish of *jutahy-sica*, dissolved in alcohol, is laid. A similar resin, said to be the product of the same species of *Hymenæa*, is used to varnish painted ware among the Maypures on the Orinoco (Humboldt, Pers. Nar. ii, 309). The Abiponian women rubbed their pottery with a kind of glue to make it shine (Dobritzhoffer, Hist. of Abipones, ii, 131). The Indians of Guiana paint their pottery with water color, and varnish it with the gum *simiri* (*Simiri tinctoria*) or *bourgoni* (*Robinia bourgoni*). In Yucatan, Behrendt reports the use of a varnish made from the *Niin* (*Coccus axin* Lallave). The Fijians glaze their ware with a resin, and the ancient Egyptians sometimes painted pottery in distemper and covered it with a resinous varnish ("Pottery, in

Chambers' Encyc.; Williams and Calvert, Fiji, &c., 53; Jenkins' U. S. Expl. Ex., 347; Birch, Anct. Pottery, i, 48, 49; Brogniart, ut supra, i, 502). Von Martius alludes in general terms to the mode of building up an earthen vessel by coiling (Ethno. Amerikas, 712); and the same method appears to have been alluded to by Humboldt (Pers. Nar., ii, 309) when he says that the natives of the Maypures on the Orinoco "purify the clay by repeated washings, form it into cylinders, and mould the largest vessels with the hand."

We meet with the same method again in Chilöe, where it has been described by Dr. Fonck (Die Indier des Südlichen Chile, &c.), who speaks of the vessel as being built up exactly as at Ereré, a flat piece being first made for the bottom, on the periphery of which the wall is formed by coiling up a sausage-like cylinder. He adds that the ware is dried in the smoke before burning (*Zeitsch.* fur Eth., 1870, iv., 290).

Gili describes the process of coiling as found among the Indians of Orinoco, and adds that the surface of the vessel is worked down with a pebble and the fingers, which are, from time to time, dipped into water, the ware being burned in pits with a fire made of bark.

Prof. Charles Rau, the first ethnologist to give due importance to the method of coiling, has, in his admirable essay on Indian Pottery (Smithson. Rep., 1866, 351), translated the description given by Dumont of the manufactury of earthenware by the Indians of Louisiana, in which an account of the building up of a vessel by this method is given (Mem. Historiques sur la Louisiane). Prof. Rau is of the opinion that the building up of pottery by coiling was practiced over a large area in North America. Certainly in South America it was widely known.

Prof. Eggleston, of Columbia College, New York, informs me that in Germany, the large crucibles used in melting are, when broken, built up again with ropes of clay. In this case we have either a survival of an old pre-historic art, or its re-discovery in modern times.

I will now give such information as I have been able to gather concerning the manufactory of pottery by the aboriginal inhabitants of America, for the double purpose of giving a clearer idea of the various processes used, and also of showing that the manufacture is everywhere exclusively in the hands of women.

Molina says (Saggio, &c., Bologna, 1872), that the Chilians have excellent pottery, which they burn in furnaces, or rather holes dug in the sides of the hills, and adds that they apply to their wares a sort of varnish made of a certain mineral earth. Schmidtmeyer (Trav. into Chile, Lond. 1824, 117) says that the present Chileños are good potters for common ware: they introduce a certain quantity of earth or sand, containing an abundance of yellow mica; and jars, holding seventy gallons or more, are made by them of great thinness, lightness and strength, and which sounds as if it were metal. The Pehuenches of Chili, a wandering tribe, made new vessels in every locality in which they establish themselves (Pöppig, Reise in Chile, &c., Leipz., 1835, i, 383).

In Bolivia, the women fabricate the pottery with much superstitious ceremony (D'Orbigny, L'Homme Amer., ii, 150, 233, 339, 363). According to Castelnau, the Chiriguanos women are excellent potters. One vessel measured by him was a metre in diameter and twelve decimetres in height (Exped. vi, 56, 307). Woman's work among the Mojos Indians comprises also the manufacture of earthenware (D'Orbigny, ut supra 233). Gibbon speaks of one Juana Jua Cayuba, a Mojos woman, who superintended the hired women who were engaged in moulding earthen jars (Expl. of the Valley of the Amazonas, p. 246).

The Guarayos women also made pottery, and D'Orbigny speaks of the large vessels in which the dead of the tribe are buried (Frag. d'Une Voy. au Centre de l'Am. Meridionale, 193).

Both the ancient and modern inhabitants of the Andes were famous potters, and the vases of the *Huacas* of Bolivia and Peru have long attracted the attention of ethnologists (von Tschudi y Rivero, Antiq. de Peru; Cat. du Musée de Sevres; D'Orbigny, Atlas d'Antiq. Peruv.; Brogniart, Arts Ceram., i, 525; Ewbank, Life in Brazil). The majority of Peruvian vessels were undoubtedly formed in two or more pieces, in a mould, and afterwards luted together. Some of these molds were made from natural objects, but others bear very elaborate raised figures.

The women of the Indians of Ucayali are represented as being the potters. The Tobas of Mbocobi of the Chaco, manufacture immense *chica* pots like those of the Chiriguanos, the work falling to the lot of the women, as was the case also among the Indians of Itaty, a village of Guaranis, situated at the confluence

of the Paraná and Paraguay (D'Orbigny L'Homme Am., ii, 100; Voyage, &c., i, 199; Brogniart i, 530).

Dobritzhoffer says, "The American women seem to have a natural talent for making various articles. They can mold pots and jugs of various forms of clay, not with the assistance of a turning machine like potters, but with their hands alone. These clay vessels they bake, not in an oven but out of doors, placing sticks around them.

The pottery of the Payaguàs, of Paraguay, was the work of women. Among the Guaycurús, pottery appears to have been woman's work, for Prado tells us that, in this tribe were found men who affect all the manners of women, not only dressing like them but occupying themselves in spinning, weaving, making pots, etc. (Hist., in Revista Trimensal do Inst. Hist. i, 32).

Hans Staden, who was a captive among the Tupinambás, relates that the women of that tribe were the potters. The vessels after having been dried in the air and painted with lines of different colors, were turned upside down on stones, and burned by heaping bark about them and setting it on fire (DeBry, Americae, 3d Part, ii, xiv, 3; See also DeBry, Hist. Nav. in Braziliam, p. 133, 141, 142, 239).

The women of the Arraial do Barro, opposite the Island of Sao Sebastiao are said to have made excellent ware (Art. de Verifier les Dates, 13, p. 110).

The women of the Mongoyós prepared the clay on a banana leaf held upon the knee. It was then placed upon a "plateau" of sifted ashes, and the vessel, after fashioning and polishing, was submitted to the action of fire.

A writer on Brazil (Noticia do Brazil, Lisboa, 1825, iii, 1, 286), says, that the old Tupinambá women made pottery by hand, some of which were big enough to hold a pipe. They also made pots, mugs and pans. This pottery, which was sometimes painted, was burned in a pit, a wood fire being made above. They superstitiously believed that if any one but the person who moulded the pottery were to attempt to burn it, the vessel would break to pieces in the fire.

Spix and Martius (Travels, Lond. 1824, ii, 246) tell us that the Coroádo women provide the requisite earthenware for the family. Pottery is still made by the civilized Indian women in many parts of Brazil south of the Amazonas. Old women make earthenware

by hand in S. Paulo. The clay is mixed by being trodden under the feet of oxen, the vessels being formed by coiling or by molding in several pieces. The clay is sometimes worked into a thin sheet, which is applied to the surface of a wooden mold. The outside is worked down with the wetted hand and the application of a corn cob. After the vessel has dried to the proper consistency, it is cut in two, the mold is removed, and the two pieces are skilfully luted together. Pottery is made in the same way in Bahia.

Except in the olarias, where earthen vessels are made on a large scale, men nowhere in the Amazon region have anything to do with this industry. (On the manufacture of pottery by women in various parts of S. America, see Baena, Ensaio Corographico do Pará, sub voce "Monte Alegre;" Candido Mendez de Almeida, Pinsonia, 1873, 28; Herndon, Explor., 202; Wallace, Travels, 172; Debret, Voyage Pittoresque, Paris, 1834, Catalogue du Musée Ceramique de Sévres; Brogniart, Arts Ceramiques, i, 532; Humboldt, Personal Narrative, i, 196; Gili, Storia Americana, ii, 315; Gumilla, Histoire Naturelle, &c., de l'Orénoque, i, 268; Schomburgk, Hakluyt Soc., Discov. of Guiana by Sir W. Raleigh, 64, note; *id.* Journ. Eth. Soc., Lond., 1848, i, 267; Art de Vérifier les Dates T. 15, 285; Perez, Jeographia de los Estados Unidos de Columbia, i, 485; Bull. Soc. d'Anth. Paris, T.i, Serie i, 1866, 403; Squier, Rare and Original Documents and Relations, p. 46; Bibliotheca de Autores Españoles, Historiadores primitivos de los Indias, i, 348).

Dr. Berendt writes from Yucatan that "certain classes of pottery, manufactured in some towns of the interior, are not only carried all over the country, but exported to other parts of Mexico, and even to Havana; among them are unglazed basins for cooling drinking water, also large and small water-jars, some preserving the ancient Yucatan forms, others imitating foreign models. These are made by men, mestizoes, and mostly by hand, on the turning wheel. In some places far away in the interior, or without any connection with the larger centers of trade, as also in Peten, the proceeding is still more primitive, and is exclusively in the hands of women. They search for the clay, load it on the backs of children, and work it on the *metate* before fashioning it with the hands. Large jars they generally form from two pieces. I have not seen that they mix their clay with ashes;

but they often mix different kinds of clay together. The class of pottery used by the poorer classes comprises the *comal*, (flat plates to bake tortillas on), *cajetes*, or small plates (saucers) for certain dishes, etc. No kind of glazing is used for this kind of pottery, but in its place a varnish is sometimes used, made from *Niin* (*Coccus Axin* Lallave), and this is occasionally painted. It is an ancient proceeding. I possess a vase, dug out at Jaina on the Gulf Coast north of Campeche, whose varnished and painted outer surface imitates admirably the design of ash wood. The pottery of the ancient Mayas shows great variety in form and in structure. Clay of different colors (dark red, light slate color, light and dark red, and brown) is sometimes mixed with mica or shell-gravel, and other substances, such as, in other parts, even wash gold. The ornamentation consists of figures and arabesques sunk or scratched into the surfaces, or elevated into reliefs and often painted. The modern pottery of the Indians is generally plain. The ancient pottery found in the interior, and particularly near the gulf-coast of Yucatan, shows a much higher art than that from the east coast, Cozumel island, etc."

Pottery making fell to the lot of the Carib women, and according to Ligon they manufactured a very handsome light ware (De la Borde, "Relations de l'origine, &c., des Caraibes, &c., Receuil de divers Voyages, p. 23; McCulloh, Researches concerning the Aboriginal History of America, p. 84).

Mr. Squier describes the pottery of Nicaragua as painted and glazed (Nicaragua, i, 287). The ceramic artists among the Indians of Fort Yuma, California, are women, and the same is the case with the Zuñis, whose beautifully painted pottery closely resembles that of the ancient Indians of Pacoval (Michler, Rep. U. S. & Mex. Boundary Survey, i, 101; Pac. R. R. Rep., iii, 50). DuPratz says that the Indian women not only "make the pottery but they dig up and mix the clay" (Hist. of Louisiana, Lond., 1774, 360).

Adair informs us that the Cherokees glaze their ware, and make it very black and firm by placing it in the smoke of a pitch pine fire (Hist. of Am. Indians, Lond. 1775, 4).

Hariot says of the natives of Virginia: "Their women know how to make earthen vessels with special cunninge, and that so large and fine that our potters with thoye wheels can make noe better" (DeBry, A brief Report, &c., 1590; Campbell, Hist. of

Virginia, 28; The True Travels, &c., of John Smith, p. 131; Strachey, The Hist. of Trav. into Virginia Britannica, p. 112). On the Georgia Indians see Bartram, Travels, Lond., 1792, 511; On the Iroquois, Schoolcraft, iii, 81, and Notes on the Iroquois in Squier & Davis, 223; On, the Hurons, Parkman's "Jesuits in America," p. xxx.

An account of the pottery manufactured among the Indians west of the Mississippi river is quoted from Hunter's "Manners and Customs of several Indian tribes west of the Mississippi" in Prof. Rau's article on Indian pottery in the Smithsonian Report, 1866, p. 351.

Among the Mandans, women were, as elsewhere, the makers of earthenware (Catlin, Manners and Customs, Letter 16).

Among the Micmac Indians of Acadia, the birch-bark vessels in which cooking is performed, are made by the women, and we have already seen how she prepares, among the Esquimaux, the stone lamps and cooking vessels.

Jewett thinks that the Celtic funerary urns were formed "most probably, judging from the delicacy of the touch, and from the impress of the fingers which occasionally remain, by the females of the tribes" (Grave Mounds and their contents, 83–85).

At Ordezan, near Bagnière de Bigorre, pottery similar tò that found in caves is still manufactured by women. Tylor speaks of a set of hand-made pottery found in use by an old woman in the Hebrides.

The Kaffir women not only cook, but they make the pots they use, the clay for the purpose being obtained from ant-hills. They also make baskets that will hold milk or beer (Wood's Unciv. Races, 77, 143; Campbell, Travels in So. Africa, 523).

Burton says, concerning the manufacture of earthenware in Eastern Africa, "The figuline, a grayish brown clay, is procured from river beds, or is dug up in the country; it is subjected to the preliminary operation of pounding, rubbing dry on a stone, pulverizing and purifying from stones and pebbles. It is then worked into a thick mass with water, and the potter fashions it with the hand, first shaping the mouth; he adds an inch to it when dry, hardens it in the sun, makes another addition, and thus proceeds until it is finished. Lines and other ornaments having been traced, the pots are baked in piles of seven or eight, by burning grass. Usually the color becomes lamp-black. In Usagara, how-

ever, the potters' clay burns red like the soil. A cunning workman will make in a day four of these pots, some of them containing several gallons, and their perfect regularity of form, and often their picturesqueness of shape, surprise the stranger. The best are made in Ujiji, Karagwah and Ugunda, those of Unyamwezi are inferior, and the clay of Zanzibar is of all the worst."

Schweinfurth states that "as in the case with the majority of the inhabitants of Africa, the manufacture of pottery is practiced by the women (*Zeitschrift* fur Ethn., 1873, i, 8).

"In Yoruba," says Bowen, "the women make earthern pots" (Central Africa, p. 308); and so, also, do those of Garo-a-Bautschi and Tesan, and the Guinea coast. We are, therefore, I think, justified in coming to the conclusion that the fictile art, in its infancy, is confined to the women is as true of Africa as of America.

In the East Indian Archipelago, the Papuan women make pottery (Journ. of Ind. Arch., v, 313; Norris' Ethnogr. Lib., i; Earl's Papuans, p. 73). While pottery is unknown in the greater number of the South Sea Islands, in Fiji it has reached a high state of development (Williams and Calvert. Fiji, N. Y., 1859, 53; Wood, Unciv. R., Amer. Ed., 930). Women have the making of pottery entirely in their own hands, and the art, moreover, seems to be confined to the women of sailors and fishermen. It is also worth noting that the Fiji women are skilled in the manufacture of stamped bark cloth, making the patterns themselves (see also Jenkin's U. S. Expl. Exp., 341, 347; Lubbock, Preh. Times, 443; Pickering's Races of Men, 163).

The facts I have given seem to show that among savage tribes generally, the fictile art is, at first, exclusively practiced by women, the reason being that, primarily and essentially, the fabrication of earthenware is a branch of culinary work, which last, everywhere falls to the lot of the gentler sex. Man, among savages, is the hunter, fisher and warrior, while the woman takes care of the house, and of the culture of the field. When, however, in the progress of the tribe in culture, the practice of the art of pottery comes to be a profession, and to interfere with household work, it passes naturally into the hands of man, and it will be found that in every case where men make earthenware the tribe has advanced considerably beyond the savage state.

But savage woman not only fabricates vessels of clay, she also

ornaments them, and if the fictile art has originated with her, and has grown up under her hands, it seems no less probable that the ornaments she uses should have originated with her, and the probability is increased by the fact that to her falls the work of spinning and weaving, of making and decorating personal ornaments and clothes, and of making baskets, mats, etc. She is everywhere the primitive decorative artist, and to-day it is the exception that man occupies himself with ornamental art, even in civilized countries. Woman covers with ornament everything her hand touches, and the lady in her boudoir industriously embroiders, on some article of mere luxury, the same series of frets and scroll borders that, on the Amazonas, the savage unclothed squaw as diligently and with as firm a hand, traces with a spine on the damp surface of the clay vessel she is fashioning. It is as if they both sang the same simple song. The ornaments in both cases are identical and not only of wholly independent origin, but it may be also of very different age. Those of the savage are the mere embryonic beginnings of art-life, while those of the boudoir, like the *Lingulæ* of to-day, are archaic forms, persistent through the ages, still flourishing unchanged among the varied wealth of derivatives by evolution from the ancient primary forms.

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SEEDS OF THE VIOLET AND OTHER PLANTS AS PROJECTILES.

BY MOSES N. ELROD, M.D.

THE capsules of the cleistogenous flowers of *Viola cucullata*, *V. canadensis* and *V. striata*, by a peculiar mechanical movement of the valves project their seeds from a few inches to four or five feet. As *V. cucullata* is a very common plant, with numerous seed pods in the latter part of the season, it has been most carefully studied, and will be the first described. When the seeds are ripe, the pod that before had been folded back on its crooked procumbent stem, becomes erect, opens into three valves that place themselves at right angles with the straightened and erected peduncle, and, as it were, look directly upwards. By straightening the peduncle, the seed vessels that heretofore had been concealed, are brought on a level with or above the leaves. Each one of the carinate valves contains from three to four rows of

seeds, attached by short funiculi to a common parietal placenta. The seeds of the inner rows being attached to the top, while the outer ones are attached to the sides of the raised keel, give to the boat-shaped valves an appearance of overloading, and are heaped up in the middle, and were it not for their slender funiculi would be spilled out by the least motion. The shooting process is now begun by the hard smooth edges and sides of the valves pressing on the outer rows of seeds below their greatest diameter; the pressure being transmitted to the under side of the seeds of the heaped up middle rows, they generally are the first projected. Usually but one seed is projected at a time, and the short funiculi permitting another one to take the vacant space, the inner rows are kept full until but a single row remains. But the movement does not stop here; it is continued, and the pressure reinforced by the outer, and sometimes the inner end of the valve coming into close contact and clasping the seed on three sides, until all are forced out, one by one, and the sides of the valve are left in contact. During the process of drying, which still continues in the now empty and useless valve, the sides are separated and it again assumes the former carinate shape. Any one seeing the dry and empty pods would scarcely think of their having gone through the changes we have described. And as the movements that project the seeds take place while the valves of the capsule are yet in a semi-green state we conclude they form an important part in the life history of the plant. The pods of the inconspicuous flowers of *V. striata*, are grown in the axils of the leafy stem, on long peduncles, and have the same movements of straightening and erection as in *V. cucullata.* The pods of *Viola canadensis* are sessile.

The projecting movement may be roughly compared to the unlading of a boat by slowly crushing the sides together.

The shooting process may be conveniently watched by gathering the mature pods after they have opened, and plunging the stem into a cup of sand; however, treated thus the valves after once closing will not again re-open. The lateness in the season at which my observations began, prevented my seeing the pods following the conspicuous flowers.

In giving the generic characters of *Pilea* in his Manual of Botany, Prof. Gray says, " Fertile flowers. Sepals three, oblong, more or less unequal; a rudiment of a stamen before each in the

form of a hooded scale. Achenium ovate, compressed, straight and erect, partly or nearly naked."

In *P. pumila* the distal end of the elastic hooded scales are held down by the otherwise naked seed. The rudimentary stamens may be compared to a V-shaped spring, the ends of which are pressed together. When the seed is ripe and its connection with the receptacle broken, the hooded scales suddenly, partially straightens and the seed shot into the air five feet or more. The arrow-head shape of the achenium, and the arrangement of the cymes on long axillary stems shortened from below upwards, are favorable to the great range of the flying projectile. The mechanism of the movement is sufficiently simple, but the special adaptation of an essential organ of a perfect flower to a new use is very peculiar.

Prof. Gray says of *Oxalis*: " Pod membranaceous, deeply five lobed, five celled, each cell opening on the back. Seeds few in each cell, pendulous from the axis, their outer coat loose and separating." The loose outer coat of the seed of *Oxalis stricta* bursts on the edge opposite its attachment to the axis, and is suddenly rolled back, breaking the funiculus, and at the same time separating the walls of the cell and projecting the seed two or three feet. By this movement the loose coat is generally turned inside out. The flattened oval seeds are marked on their sides by transverse striæ that doubtless give direction to the elastic coat when it bursts. Before the seeds are fully matured they may be removed from the cell and the coating caused to burst by touching them with some sharp-pointed instrument. So quick is the movement that one is strongly reminded by it of a jumping flea. No other species than *Oxalis stricta* was observed.

That the movements of the seeds described are important, if not essential to the life of the plant, seems evident. The ripening capsules of the violet may be found until late in autumn, we have seen them after snowfall, and without some such movement as has been mentioned, would go on seeding the same ground the season through, and year after year. The same remark is true of the wood sorrell, the membranaceous pod of which would otherwise fall to the ground near the root of the plant carrying its crop of seeds with it. The general resemblance in habit and appearance of balsam and richweed would lead us to expect some special provision for scattering their seeds in the one as the other

It may be further noticed that while the movements described are each different and peculiar to a single genus of plants, they are unlike those of the well-known balsam, and those of the witch-hazel as given by Mr. Meehan a few years since.

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INSTINCT AND REASON.

BY F. C. CLARK, M.D.

IF the great array of startling facts, presented in the works of Mr. Darwin, be not wholly convincing, they at least clearly demonstrate a somewhat closer connection of man with lower organizations than has hitherto been acknowledged. Since the invention of the microscope and its application to the natural sciences, the study of natural phenomena has opened a field of inquiry never before dreamed of by the most imaginative theorist. Myriads of infinitesimal forms of life, which formerly escaped detection, have thus been revealed, and though many a one lacks that complexity of organization which usually attracts our notice, yet even in their simplicity they present a problem as intricate and perplexing as the most highly organized being. These minute organisms often seem but mere centers of life (points of attraction), around which cluster other existences still more minute and but just perceptible to the highest powers of the microscope. Organization appears, many times, hardly more than nominal. Even to-day their nature defies solution, so as to render it impossible to assign them any satisfactory place in the scale of being; and after the new discoveries daily added, the naturalist is at a loss to find the dividing line between the various forms of life expressed by the old names of "animal" and "vegetable."

The division of the living world into the "vegetable" and "animal" is at best but arbitrary. It is not enough to take well characterized types of each division and compare them with each other. Such differences would be self evident. But, instead, it is needful to give such a definition of each division as will cover every variety, however diverse, which is included in that division to which the definition has been given. Thus, much confusion in classification is avoided; though, unfortunately for us, the problem remains unsolved; for the new facts daily brought to light render necessary continual changes in classification, and

broader definitions. In the present state of natural science the best classifications cannot be otherwise than approximate and unsettled. But the link between unorganized and organized matter has thus far defied discovery. Whether the different expressions of existence are due to that inherent change exhibited by all matter—that change in which all natural phenomena consists, resulting in a spontaneous generation, the necessary elements or factors being present; or whether to a special creation to satisfy each individual case, as a species; these are questions still under dispute, whose explanations have their different disciples.

Passing by that which makes up the organization of all living beings—the mineral—it is designed in the following pages to discuss the manner in which the different vital forms express their existence under their different phenomena, dependent of course upon their individual organizations. Hence organization determines the character of the individual as well as of a species or family. But it should be here stated that it is not intended to discuss the province of a species. This is for the specialist.

Again, we are to observe how each organized being supplies its wants and the means or organs for supplying them. In every form of life, however high or however low in the scale of being, there must necessarily be some way in which each form maintains its existence. It is not to be expected that all vital beings, irrespective of their organization, demand the same mode of supply, but some means of supply. Each after its own kind must so dispose of the elements of nutrition about itself as best suits its organization. Each one, therefore, will take from the alimentary substances it receives only that best suited for it, or is refused, or avoided by other higher or lower forms. In this way that constant change of elements is effected by which all life is supported; by which the structure of one is fitted for a higher form of life; and the detritus of a higher prepared for. a simpler and more lowly being. Thus does the vegetable supply the animal with food, and in turn the animal adds to the growth and vigor of the plant. The luscious fruits of the garden, which form a part of the delights of life, contain the same elementary principles found in man, but there taken at second hand. The vegetable being a builder up of tissue can exist where the animal would become extinct, for it is the tendency of all animals to destroy combinations and to form compound products.

Now, for these various forms of life to effect these important and complicated results, there must needs be some power behind all capable of directing the phenomena manifested in each individual. The selection of the required food, the choice of a habitat, and the end of all—the ultimate propagation of its kind—are by no means mechanical phenomena.

The general opinion has hitherto been, that man was guided by intelligence or reason, and the lower animals, without exception, by instinct, differing most essentially from reason in that it was innate. Gradually, however, many of the actions of the lower animals, as well as some of man which were regarded as instinctive, were acknowledged to be intelligent. These actions were supposed to be the same in kind, but different in degree. A step was thus made in advance; and what could not be longer denied forced itself upon the attention of all.

It is a matter of peculiar difficulty to draw a line of distinction between instinct and reason. The best thinkers, among whom may be cited Herbert Spencer, consider that no *hiatus* exists between the two, but that the one passes into the other by insensible degrees.

Simple reflex action, sometimes called "reflex action of the spinal cord," is wholly unconscious action. It is the action of muscles seen in decapitated frogs, and in acephalous children (monsters) who, in their short life, perform simple acts as readily as babes with brain intact. Herbert Spencer supposes the simplest acts to be unconscious, performed by the animal automatically, in its endeavor to get rid of offending matters. And this acquired power is inherited and becomes then instinct, or complex reflex action of another sort.[1] Instinct is the inheritance of accumulated experience; is also a lower grade of intelligence, into the highest of which it gradually develops. The dog after having been taught the trick of "begging" will transmit that faculty to its offspring, which will be used as occasion requires.[2] Mr. Lewes and Mr. Spencer appear to agree in regarding instinct as being lower than reason. Acts which were once voluntary and intelligent may become involuntary and habitual, then instinctive. And as acts became more complex they become less frequent, and more subject to the control of the will. Hence instinct is "lapsed intelligence," so to speak.

[1] Psychology, Vol. i, p. 432 and foll.

[2] Problems of Life and Mind, Vol. i, p. 208 and foll.

Some French writers and others do not separate impulse from instinct. This, Mr. Lewes opposes, since in instinct we see only one course of action often followed, when other sources as good may be at hand. This course of action is the result of accumulated experience inherited from the parents. But at the same time a change in the course is sometimes manifested, which would imply a slight degree of intelligence. From this it follows that reason differs from instinct but in degree rather than in kind, as instinct does from impulse. But as impulse denotes the suddenness of an act, and as an instinctive act follows so swiftly after the impulse or desire has once been formed, it becomes very difficult to separate the two. Roughly speaking then, instinct may be described as the *directing force* in simple habitual actions; while reason, in every case implies conscious memory, and may be viewed as the *guiding and directing force in every act which is not habitual. It is the putting in order of the proper apparatus to work in the best direction; or the proper selection of the best mode of acquiring wants.* In instinct then we have no consciousness of action, but reflex acts performed automatically. Hence the common error of applying intelligence only to the acts of man cannot be too much deprecated. Instinctive acts are as common among men as among the lower animals; and even in some species of plants, we note phenomena so wonderful as to cause some hesitation in classing them entirely among instinctive acts.

The theory of evolution aids us greatly in explaining many of the phenomena observed in the lower forms of life, perfectly inexplicable by any other mode of inquiry. From the simple and hardly exertive act of the monad to the complex and manifold actions of man, we cannot fail to perceive a constant progressive development, undeniable and indisputable. Each separate principle, if separate and distinct it be, overlaps another, there being no chasm, no break to evince the beginning of one and the ending of the other. The simple reflex act becomes compound; phenomena cease to be involuntary, and become conscious and intelligent.[1]

First Forms of Life.—In regard to those transitional forms of life whose place in nature has not yet been determined, which multiply like the individual cells which make up animal and vegetable structures—by fissuration—little can be said respecting

[1] Principles of Psychology, Vol. i. p. 432 and foll.

either their instinct or reason. But that one or both these principles must be present, can be best seen from their analogy to higher forms.[1] But if, as Herbert Spencer teaches, instinct is but compound reflex action, and if in these lowly beings we observe simple reflex action to predominate over compound, it is but a step to invest even these transitional forms with some degree of instinct. And again following the same author, we cannot fail to see, from analogy at least, some degree of reason, however slight.

It is seemingly so immaterial to this class of beings as to their place of abode, and so easily and rapidly do they reproduce their kind, that it is not surprising that the theory of spontaneous generation should have received so much attention and gained so many partisans. Still, in what light soever they are viewed, they must be allowed the requisite elements of growth and function; for without these they must as truly perish as the higher forms of life when they, too, are deprived of proper function and nutrition.

Whether regarded as animal or as vegetable, these lowly forms must be conceded some skill, however slight, for obtaining wants and for protection against enemies. Few, if any, of the higher forms of life are unprovided in this respect. Thorns render plants less liable to injury. The cuttle-fish stains the water in the track of its enemies of an inky blackness, and thus escapes. The spider simulates death; and so does many a crustacean. The polyp can be severed into hundreds of fragments, but it revenges itself by reproducing as many new individuals; and the mollusc is protected from foes by a hard closed shell.

Our knowledge of the lowest of the protozoans is but scanty, yet they all have means for engaging successfully in the struggle for existence. Each protozoan, or other, must put forth efforts proportioned to its development, to be met and overcome by still higher development. Something is displayed in the contest of offence and defence which seems like intelligence, but more akin to instinct. Their actions observed here are so nearly related to reflex action alone, that the problem of separating instinct from pure reason is at present utterly impossible. But yet where observation fails analogy will perhaps succeed.

Now if, for example, we touch with the point of a fine needle

[1] Vid. Pop. Sci. Monthly, Dec. 1873, p. 180.

one of those beautiful bell animalcules, named Vorticella, it instantly darts backward as though attached to a tense elastic thread. If we observe it more carefully we perceive the stem of the bell flower to be gathered into several spirals like a helix. After a while the animalcule recovers from its fear and extends itself, spiral after spiral being shaken out. If the vessel in which they are contained be jarred even, they dart quickly backward as if touched. After a short time they get accustomed to jars and the like, and a considerable shock is required to cause them to withdraw into the depths of the vessel. Now here at least, some impression, strong enough to affect them greatly, is made upon these little bell-flower animalcules. If instinct be advanced to explain this phenomenon, then the onus of proof, as to where instinct ends and reason begins, belongs to the one who advances that idea; if reason, however small, then we must allow the consciousness of action to obtain in all the processes of nature.

Every form of life, then, whether animal or vegetable, does but furnish different modes of expressing life. What is lacking in one is made good by approximation, so far as it is consistent with the needs and demands of that organism. The plant has no brain, no blood circulation; but the sap of the plant is pumped up by the rootlets throughout every part; and the circulation here is as perfectly established as in the animal, though in a different manner. For their purposes in life, then, these transitional beings need no complexity of nervous system, roots and sap. They would have no call for them in so simple an organization as they possess.

Plant Life.—A plant, as we understand it, is a cellular organism, consisting of a part below ground called the roots, and a part above denominated stem, branches and leaves. Parasitic plants have properly no roots, but, as their name implies, subsist upon higher vegetable forms. Air plants, fungi and lichens also belong to our category of plants, although differing so widely from our type.

Plants, being for the most part limited in motion, shoot out roots in all directions beneath the ground in search of elements of nutrition, rear a stem aloft, push out branches and put forth leaves to catch the sunbeams, by means of which they decompose the atmosphere to obtain the proper requisites for the life, respiration, growth and vigor of that form of life. The plant never

fails to direct its stem, branches and leaves towards the sun ; and in our typal plant, roots never fail to be thrust downward into the earth, in what form soever it may be placed in the ground. Leaves often change to roots, and roots in favorable circumstances become leaves. The greater the spread of foliage the more vigorous and, consequently, the healthier will be the condition of the plant. At this point it may be well to note a universal law or principle: the more sunshine and air (of course at some time reaching a limit) the more abundant the foliage, and the denser the foliage the stronger and more flourishing the plant. This may be proved by comparing out-door plants with badly managed in-door and hot-house vegetation. Plenty of sunshine and air soon show a marked change for the better.

Illustrating the subject by means of our type, we find the organs of a plant to be roots, leaves and the modifications of the leaves for reproductive purposes. The stem, or trunk, is but a canal, altering in size to suit the varying conditions of the plant, and is used for purposes of alimentation and the circulation of vegetable products between the roots and the leaves. The growth of the stem depends upon the same law which governs the growth of the roots and the branches upon which the leaves are supported. In a word, the stem seems to act as a support for the leaves. Growth itself depends upon the proper assimilation of the elements of nutrition derived from the chemical changes occurring in the roots and leaves, and to some extent in the stem.

Marine and fresh water algæ, if deprived of roots, have in their remaining organs all the functions necessary for their peculiar mode of existence.

The structure of a plant is cellular, showing its origin to be from the segmentation and accumulation of cells, one upon the other. The microscope shows how beautiful is the plant tissue, and how different in different varieties, but in every one this distinct cellular formation is apparent.

The plant is also possessed of the means for assisting its growth, as runners, creepers, tendrils and the like. For reproductive purposes it has nettles, thorns, elastic fibres, as in the seed vessels of the squirting cucumber (*Momordica claterium*); but above all in its essential organs of reproduction—its flowers containing the stamens and pollen, ovary and pistil. The first

class of propagating agents are secondary or non-essential, the latter the essential organs. The former passive agents, the latter active.

Thorns, briers, nettles, etc., are also passive elements of defence. For offence many plants have a singular apparatus, especially that curious class of plants termed insectivorous, or carnivorous, hereafter to be discussed.

But the plant demands food. This it obtains in a peculiar way. Its anatomy and physiology are adapted to that peculiar way. It does nothing contrary to nature with impunity. Mode of growth in all plants tend to the same end. Hence the lowest as well as the highest can do no more than supply wants ; seek a situation best suited to its growth and development; remove or avoid obstacles interfering with growth, and reproduce its kind in due time. For this purpose certain organs are exercised, and this constitutes the functions of a plant.

In plants, as well as in animals, we everywhere perceive the operation of the law which secures to them what naturalists term "the survival of the fittest." The weaker must succumb to the stronger, and disappears, is annihilated, when the struggle for existence becomes too great for that form of plant life.

Plants which need much air (or elements of air) and light, and moisture, are found in situations most favorable for obtaining them ; if deprived of them the result is obvious.

In the case of most terrestrial plants, a suitable depth and character of soil are required. If the soil be too poor in the elements of nutrition required by a peculiar kind of plant, or in excess, or the soil too dry or too light, the different elements must be duly supplied or apportioned, and sufficient moisture furnished by irrigation lest the heat of the sun destroys the roots of the plant. The same principles are observed in respect to all the classes of the flora spread over the earth. Warmth implies light or sunshine, and where it is wanting none but the lowest orders, like the lichens and algæ, survive. The different climates also possess their own vegetation, and even in different regions of the same zone we find plants totally distinct from each other. Hence circumstances, as well as conditions, must find a place among the demands of a plant.

For the removal of obstacles the plant has two courses, to disintegrate the object opposed to its progress, absorbing it if it be

a suitable nutritive element, as are all animal and vegetable substances and some minerals; or pass around it; or still again, as in extreme cases, to bury it up in its own substance, as are stones, bayonets, nails and the like.

For its protection, defence and reproduction the plant has at hand sufficient means. Some of the many devices for these purposes have already been noticed. The manner of plant reproduction is familiar to all; the object being in all cases the contact between pollen and ovary or seed vessel. In this way the propagation of most plants is effected. In regard to the flowerless or cryptogamous flora, spores, it will be found, take the place of seeds proper. Yet for all that, the principle of reproduction remains the same in both divisions.

Such, then, are the organs, functions and factors exercised in the life of a plant. It now remains for us to consider how these are put into action according to the means at hand, pursuing as the plant does, many times, a most reasonable course, and acting in a manner so peculiar as to excite our wonder and admiration. We must first remember, however, that we have to do with a form of life whose phenomena have been but little studied, for it was not till late in the period of the *Renaissance* that botany became a a separate science, and that plants had a natural classication of their own.[1]

Plants are susceptible of improvement, which is well shown by cultivation. Thus flowers take upon themselves a great variety of forms and colors, and sometimes to so great an extent as almost to deserve to be classed as new and distinct species. But yet there is sufficient likeness between them, some characteristics traceable to the original stock; or some peculiarities due to inheritance; some similitude to the parent to make them belong to the same species. Darwin considers all the different species, or varieties of pansy to be derived from one parent, as may be said in reference to the pigeon and the dog kind.

Trees often adapt themselves, in a remarkable degree, to the surrounding circumstances. Thus the feral oak, growing as it does in the midst of other trees, which oftentimes are densely crowded together, sends out branches at a more acute angle than does the meadow or cultivated oak. Much difficulty is experienced in cultivating the feral variety, so as to give it the grace and

[1] First Nat. Sys. Bernard de Jussieu, 1759; Figuier Vegetable World.

beauty of the meadow oak. Other trees, like the walnut and chestnut, present the same peculiarities.

Plants appear to possess sensibility, and often to a remarkable extent. If the well-known sensitive plant be touched never so lightly, if but a breath blow upon it, its flowers and leaves close; and some time elapses ere it dares to expand them again, as if it knew the danger threatening it. If only a sister leaf be touched the rest close as if out of sympathy.[1]

Drugs exert their peculiar influence upon plants as upon the higher animals. Spirits of ammonia, if applied too strong, will be fatal; opium puts the plant as effectually to sleep as it does man; prussic acid is also destructive; electricity exerts here its peculiar and wonderful effect.[2]

In plants, as in animals, we sometimes observe what is termed "suspended animation." This phenomenon is well instanced in the "resurrection plant," generally known as the Rose of Jericho. It is found in Arabia, near the shores of the sea, to all appearances a mass of dry, dead vegetable fibre. But when sufficient moisture is supplied, it revives, its leaves expand, it is clothed in new verdure, and as it blossoms unfold, the reanimated plant is clothed in all its former beauty. No wonder is it that the Rose of Jericho should be almost adored by the simple people among whom it is found.[3]

The Sleep of Plants.—When night approaches, flowers close their petals, and thus at rest, only wake when the sun once more ushers in the day. DeCandolle, as did Linnæus before him, made many experiments with plants in this particular. At night, plants were exposed to a bright light, and during the day were placed in a darkened room. After some irregularities, the change of conditions was finally adopted by the plants, and in the lighted room they would blossom, and close their petals and leaves in the darkened one.

Some plants, however, only flower at night. The beautiful Yuccas, a species of wild lily, only blossom when the moon is out. The night blooming cereus only blooms as its name indicates. Hence the time, as well as the season and the climate, etc., seem to be elements of importance in the flowering of plants. These conditions may be slightly varied, as seen above.

[1] Vid. "Wonders of Vegetable World." Scherl De Vere.

[2] Ibid.

[3] Ibid.

The Movements of Plants.—Slow motion is obvious in all plants, as in their growth, and in their tendrils, creepers, etc. But the most rapid and continuous motion probably possessed by plants, is exhibited in the *Desmodium gyrans*, of India. Each leaf of this plant consists of three parts, two external and small leaflets, and one central and large leaflet. The external leaflets move up and down in alternate jerks, at the rate of sixty a minute. The central one moves but little. This motion is continued during all the seasons of the year, and during the whole lifetime of the plant. Warmth and moisture, however, expedites the motion.[1]

The Offensive Weapons of Plants.—The first of these offensive plants is the familiar Venus's fly-trap (*Dionæa muscipula*) which sets its traps, and woe betide the unwary insect which ventures near the the hidden toils, allured by its attractive appearances. The springs are all set, the prison prepared and sure destruction awaits the victim.

The *Darlingtonia californica* belongs to the pitcher plant family. Its appearance has been likened to a cobra in the act of striking. The beautiful "red wattles" within the brim of its pitcher offer irresistible attractions to insects, especially to flies. These alight first upon the "wattles," then flying upward strike the pitcher, and owing to the peculiar twist of its walls fall to the bottom of the receptacle, where many another thoughtless fly has, too late, found its sepulchre.[2]

Dr. Erasmus Darwin,[3] grandfather of the celebrated naturalist of the same name, about a century ago, advanced many curious theories respecting the consciousness and volition of plants, in a work under the title of "The Loves of the Plants." This book at the time was much ridiculed. Plants seem to put on their most gorgeous dyes for the same purposes as the animals; and the idea of the "loves of the plants," though seemingly absurd, needs more investigation ere it be wholly discarded and ridiculed.

Plants not only actually eat and digest animal food, but also drop the insects they have destroyed, upon the ground, and thus fertilize the soil.

Dr. Hooker has described several kinds of plants which subsist upon animal food, and are hence termed carnivorous. The

[1] Wond. of Veg. S. de Vere.

[2] Loc. cit.

[3] For what follows, vid. Sci. American Dec. 22, 1874, and July 3, 1875.

present Mr. Darwin has investigated the same subject very carefully, and found that when a fly was caught by one of these plants, it would be dissolved in a gastric fluid exactly like that of the animal stomach. Pieces of beef and the like, when subjected to the same process, were acted upon in like manner. Hard mineral substances, like chalk, would, after a time, be rejected by the plant, though seized upon at first like the rest, shall we say as soon as it found out its mistake? [1]

In this country a lady has enlightened us greatly upon this subject by her interesting labors upon the bladder wort (*Utricularia neglecta*). Mrs. Treat has studied the habits of this plant very carefully, and learned that it allures animalcules by means of its bright flowers and leaves glistening with dew. The water bear and other microscopic forms of insect and vegetable life seem to be its food.[2]

Instinct and Reason.—On analyzing the various opinions formed at different times in the world's history, in regard to the reasoning power, or consciousness of action displayed by plants, we shall meet with extremists on both sides of the question. Passing over the mythological accounts of plant metamorphoses, so attractive to the refined Greek and Latin, we only advert to the mental faculties with which the ancients were pleased to endow many plants.

Many in more modern times have lavishly bestowed souls upon plants, as did Adanson, Bonnet, Hedwig and Edward Smith. Martius and Fechner, of Germany, defended these views, and were very liberal in their supply of souls to plants, even regarding them as sentient beings.

Another class, taking the opposite side of the question, among which may be reckoned Hüler, regarded plants as only susceptible to the material influences of the universe. So Descartes made all animals, so far as he could, mere automatons.

The views of naturalists of our own day are more consistent with nature and common sense; that all plants obey as infallible a law as do animals, and are subject to like influences as was observed above. Bichat in his great work on "Life and Death,"

[1] Huxley found in plants something comparable to a nervous system; Darwin something comparable to reflex action.

[2] New York Trib., Feb. 1, 1875; also Darwin's "Insect. Plants," Sir J. Lubbock's "Brit. Wild. Flowers."

admits that plants show a life as active, and a sensibility as great as do most animals.[1] Any disturbance of the conditions under which plants thrive are as fatal as the subversion of the relations upon which the lower animals and man himself depend for existence.

In the investigation of this part of our subject, we must remember that we cannot see exhibitions as great as in the more complex forms. Each plant, transitional or not, displays in the struggle for existence and the survival of its kind, a force, an influence almost as great and wonderful as is exhibited by mankind. And though standing above all this, as head and chief, man is too often forgetful of the relation he bears to the innocent weed that is in the pastures bred; too thoughtless, many times, of the vegetable on which he depends for his subsistence and being; too ignorant of the chain which leads from the lowest vegetable form, to the beauty and perfection of his manhood.—[*To be continued.*]

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THE DISCOVERY OF "TURTLE-BACK" CELTS IN THE DISTRICT OF COLUMBIA.

BY W. J. HOFFMAN, M.D.

ALTHOUGH the rude stone implements forming the subject of this paper were not found under such circumstances as to assign to them the age that some have suggested, yet the term "turtle-back" is retained for the purpose of distinguishing them from the ordinary modern rude forms, and to illustrate their relationship to some extent to the older and *typical* specimens described and figured by Dr. Abbott.[2] Before giving a description of the implements, the locality of their discovery will be necessary. The surface thus far examined, covers an area of less than two acres in extent, and is situated on the left or south bank of the eastern branch, in Uniontown, D. C., about an eighth of a mile above the bridge connecting that town with Washington city. From the branch southward, the surface gradually rises in elevation, and the region upon which the chief specimens were

[1] Loc. cit.

[2] Am. Nat., x, p. 331; Tenth Ann. Rep. Peabody Mus. Am. Archæol. and Ethnol. II, pt. 1, 1877. pp. 30–43. figs. 1–3; Eleventh Ann. Rep. Mus. Am. Archæol. and Ethnol. II. pt. 2, 1878, pp. 223-257. figs. 1–4.

found is about fifteen feet above low water mark. This sloping surface consists of fine sand, resting upon a layer of water-worn pebbles of stratified drift. The latter is a continuation of the formation known as the "cobble-stone" drift, upon which the eastern portion of the city of Washington is built. At several localities in that portion of the city, street cuts show exposures varying from five to forty feet in thickness. The several layers of worn and rounded boulders, "cobble-stones," gravel and sand, retain a perfect uniformity of stratification, showing their original deposition and arrangement through the action of water. Upon nearing the Branch we reach the shallow valley worn by that current, and the upper stratum of drift though much lower than farther back in the city, is not low enough to reach the level of that stream even at high tide. Examinations indicate, however, that the upper stratum on the north side of the stream, and the stratified gravel at the locality where the implements occur are the same, their continuity having been destroyed by the body of water just mentioned.

The rude implements were found about one hundred and fifty yards from the edge of the water, associated with quite a variety of more modern manufacture, which, by the way, were, with the exception of two or three examples, all made either of white, vitreous, or nearly transparent quartz. These represent spear-heads, arrow-heads and scrapers of great variety of sizes; some of the latter consisting of split pebbles, nicely finished by chipping, leaving the convex side to retain nearly all of the original surface. Many of the arrow-heads have been manufactured in this way, by cleaving the pebbles and finishing up a few irregularities. The smallest specimens are represented by scrapers, probably used in smoothing down arrows; these are made of tabular pieces of *semi-transparent* quartz, about the size of a five cent nickel, shaped nearly like a horse-shoe, flat at base, and have the opposite convexity nicely beveled.

The next class of implements represent manufacture of a ruder character, and undoubtedly points to greater age; to the earlier and lower state of the art of working stone for pointing weapons. These consist of quartz, and rarely chert, being rudely chipped and flaked, always leaving a greater irregular convexity upon one side of the specimen than upon the other, forming an intermediate grade between the modern forms and those termed "turtle-backs."

The latter is the class to which I desire to call special attention. These lie scattered along various small ravines formed by the rain, mingling with pebbles and modern relics *ad libitum*. They are all made of characteristic yellowish or grayish-brown quartzite, a material used in every instance, which has not been found to occur in a single individual of the two preceding varities. In form they are true "turtle-backs," if the term is admissible. The variety of forms thus far discovered are represented by that undefinable shape usually termed *celts*, and spear-heads.

An examination of a celt gives the following measurements, in inches: length 4.6, width (greatest) 2.4, thickness 1.85. The anterior surface, or that side upon which we find the "turtle-back" elevation, rises to 1.38 above the average line of the cutting edge; while the posterior or opposite side rises to but .47 of an inch beyond the same line. The top of the greater elevation retains part of the natural worn surface of the cobble-stone from which the specimen was wrought, showing the implement to have been manufactured near the locality. The cutting edge though still sharp, is very undulating, owing to the removal of large flakes during manufacture. Secondary chippings, ending in a perfectly continuous edge, shows the relic to have been a complete specimen and not a core, as has been suggested upon the discovery of similar forms. Another reason is, that not a single arrow-head or other specimen has as yet been found, even upon the closest examination, although the flakes would serve to furnish materials for arrow-heads, which could measure, when finished, nearly two inches in length. Considering the nature of quartzite, such utilized flakes should be found, as no disintegration or decomposition could obliterate their form so long as the bodies from which they have been flaked fail to present any changes upon their surface.

The only spear-head found, thus far, presents the same peculiar irregularity, but is especially interesting on account of its great comparative thickness. The specimen is 2.5 inches in length from the projection on the base to the point, 1.8 of an inch broad, and 1.2 thick. The cutting edge is sharp, continuous all around, and slightly undulating, the latter being the result of flaking. Secondary chippings are visible at different points. The anterior lateral cutting edges converge at an angle of 90°, terminating in an extremely delicate and acute point. The "turtle-back" eleva-

tion reaches its extreme elevation less than half an inch back of this, forming an angle of 64° when viewed from either side. Toward the base the descent is more gradual, where there are deeper notches than usually occur, the projections on either side somewhat worn, showing traces of having been used. From all appearance such an implement, as nearly all of this type, appears useless in attempting to penetrate the skin of anything more resisting than that of fishes.

It is very probable that these rude implements were not manufactured and employed by the Indians of historic times who inhabited this region. The question is asked, Why then do these implements occur with more modern ones upon the surface, or in washes? The only reason that can be given is, that the rude forms occupying that portion of the stratum of sand resting upon the gravel, and those of modern manufacture occupying the surface of the later deposit of earth and sand, were brought together by the removal of the intervening siliceous matter through the prolonged and repeated agency of rains. Thus the surface relics were gradually let down, as it were, as the sand and earth were washed away. This may appear unsatisfactory, but the suggestion is based upon the following reasons: *first*, that the sand being fine and easily removed by water (through the agency of rains) falling over this locality and over the bluffs, follows the most natural course towards the stream, taking with it the light silicious particles, and washing them away from the pebbles, stones and implements, allowing them to be deposited in an indiscriminate mixture in the little water courses and ravines; *second*, that this has been the case is apparent from the fact of its occurrence in several places at this time; also that small embankments and hillocks occur, consisting of gravel thus deposited or brought together by the removal of the lighter soil; and at this day, after any continued or hard rains, numerous accumulations of pebbles, amongst which we find implements, are formed by the removal of earth and sand by the temporary streams.

In this way the surface remains have not been carried away from the localities upon which they had rested, but were gradually dropped to a lower horizon, until after a time they reached the stratum containing the rude and more ancient varieties.

In this connection I shall speak of several localities in Pennsylvania, one of which occupies a position in the eastern portion

of the city of Reading, and another a short distance below that city. The rude implements found at these places have been remarked upon by Mr. A. F. Berlin in a recent number of the *American Antiquarian*.[1] The first named locality is the one upon which Mr. Berlin first noticed the occurrence of rude implements bearing the typical characteristics of so-called "turtle-backs." A few days after this discovery I visited the place, and found various examples, consisting of "celts," spear-heads, arrow-heads and scrapers. These were found over a small area only, occupying the top of a small limestone bluff. A small stream known as Mineral Spring creek passes near the base of this bluff, the intervening soil consisting of loam and dèbris from the more elevated regions. Immediately above, and resting upon the stratum of limestone, is a stratum of sand and pebbles, which has been washed away along the immediate declivity of the embankment, exposing the rude relics above referred to as found by Mr. Berlin. I found that this stratum of sand was covered by earth and gravel from the neighboring hillside, with which it was continuous, excepting along the greater declivity where the rain had worn away the super-stratum, exposing the sub-stratum of sand and rounded and worn pebbles, which occurred in accumulations where they had been washed into the ravines. Modern types were also found here associated with the rude implements, but the latter were not found on the upper stratum, even where the ploughing of long continued cultivation and local denudation has removed considerable soil; but farther down the modern forms have been washed down and lowered by the removal of sand and earth to reach the more ancient stratum containing the "turtle-backs."

This stratum of sand and gravel, or, more properly speaking, pebbles, continues eastward horizontally, as was proven by the digging of a well. Nearer the hill, where this excavation was made, the workmen reached a layer of stratified sand, pebbles and cobble-stones at a depth of about forty feet. Upon examination this proved to be the level (if run horizontally towards the bluff) of the one containing the implements. Since then this stratum has been detected along the valley a short distance, proving it to be the same, the great amount of dèbris and soil from the mountain side being accounted for where the well was

[1] Vol. i, No. 1, 1878, pp. 10–12, pl. facing p. 16.

dug, because that lies nearer the slope which rises at an angle of about 16°. This fluviatile drift, as it seems to be, formed the bed of an ancient body of water; but whether the implements found date to that period or a little later, it is impossible to decide. Were it possible to continue the search by digging at various places and depths to ascertain if the implements occur elsewhere than at the bluff, more might be learned, though it is very improbable, as will be shown farther on.

Dr. F. M. Endlich informs me of the occurrence of ancient shore lines on the eastern declivity of the neighboring hills, which may mark the surface of the same stratum occurring on the western side, as the continuation may be traced interruptedly around the hills, following the course of the Schuylkill river. The implements found at the last named locality present no appreciable difference from those occurring at Uniontown. Their conformation, mineralogical composition, typical workmanship and even the color of the materials correspond in all respects. Forms from Reading are figured in the *American Antiquarian*[1] by Mr. Berlin. Some in my possession are identical in form, but several are more typical of that class found in the drift at Trenton by Dr. Abbott, and the illustration[2] given by him represents one celt perfectly. This striking similarity is certainly remarkable; and considering the persistence with which the New Jersey celts are reproduced at Reading and at Uniontown, there appears to be greater relationship between the manufactures of the three varieties than has been accredited, or that we may be able to account for. One, and it may be be considered the strongest objection to this suggestion, is, the difference in altitude above the tide water between the several localities. Another is in regard to the geological positions of the implements.

In another locality, one mile south-west of Reading, on the right bank of the Schuylkill river, numerous specimens of these similar rude implements have been obtained. They likewise consist of the same species of quartzite, and are typical "turtle-backs." This locality covers about two or three acres in extent, sloping very prominently towards the river. The soil is sandy, and differs in this respect from that lying immediately around it, has been under cultivation for the last sixty or seventy years, and

[1] Vol. 1, No. 1, pl. facing p. 16, figs. 1–3.

[2] Tenth Ann. Rep. Peabody Mus., i. 1877, p. 33, fig. 1, a–b.

through the repeated plowing, harrowing and the effects of rain, much of the original super-stratum have been removed, exposing the older layer of stratified sand and river gravel. With the latter we find more of the rude implements, which consist of celts, spear-heads, arrow-heads and scrapers.

In all of the localities referred to, a peculiar variety of quartzite has been employed, which was found to exist in the "cobble-stone" drift in the District of Columbia. At Reading we do not find it, nor within forty miles of that city, to my knowledge. In each of these regions, the specimens partake of a character of workmanship that is rude and primitive in the extreme, and just such implements as might reasonably be supposed to be required by a rude and primitive people.

Assuming that such a race preceded the Indians—of which there is scarcely any doubt—several important points present themselves which are difficult of solution, viz: *First*, the length of time that elapsed between the disappearance of one race and the appearance of their successors; *second*, at what approximate period the manufacturers of the rude implements occupied these regions; and *third*, whether the colony occupying the region about the Eastern Branch, was of immediate tribal connection of those whose remains survive at Reading?

In answer to the first point, nothing can be definitely known, though it would appear from slight geological evidence, that considerable time had elapsed. Various traditions have been handed down to us regarding a race corresponding to the Eskimo, which, if accepted, would allow scarcely any time for the soil to have been without occupants; for that race was, according to said tradition, driven northward by the encroachments of the Indians.

Regarding the second point, the locality in the eastern portion of Reading furnishes the greatest antiquity. Here the original stratum, in one section of which implements have been found in such a condition and under circumstances to lead us to infer that they had been buried there by the gradual accumulation of detritus from the mountains; but whether any specimens occur in the stratum of drift, at any distance under this upper accumulation, is not known. The excavation, showing the drift stratum at forty feet below the surface, is nearer the mountain, and the mass of earth and dèbris may have required but a short time for deposition geologically. Beyond this elevation the valley was, at some

remote time, submerged, but has become narrowed down through the same agency from different directions. Being guided by the manner in which the implements were found, and other meagre evidence, one would suppose them to date back to the lacustrine period, but in this we find difficulties which can be explained in answer to the third point.

The difference in elevation between this locality and that on the banks of the Schuylkill river (as well as that on the Eastern Branch) is too great for them to have been occupied simultaneously, unless we throw out the suggestion of a lacustrine period. Acting upon this, the matter becomes more comprehensible, from which may be deduced the following propositions, viz:

1st. That the three localities were occupied by a similar people, at or nearly at the same time.

2d. That these people lived chiefly upon fish, as is inferred from the implements which, under *ordinary* circumstances, would be worthless in the chase.

3d. That these typical forms of rude workmanship, indicate greater antiquity than we find represented in the rudest forms of Indians who subsequently occupied the same localities. And—

4th. That the position of some of the implements in the stratified drift, and their relation in this respect to the location of modern relics, indicates an indefinite lapse of time from the disappearance of this primitive race to the appearance of the Indians proper, whose rudest forms of workmanship are found near or upon the surface.

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RECENT LITERATURE.

BREHMS'S ANIMAL LIFE.[1]—The volumes that have been previously noticed of the series, have related to the vertebrate animals, which are naturally in a work of a thorougly popular character such as this, treated of at much greater length than the invertebrates. The present volume has been written by Prof. Oscar Schmidt, of the University of Strasburg, who is distinguished for his knowledge of the structure and mode of development of the lower animals.

This volume begins with the Crustacea, and descends through

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite umgearbeitete und vermehrte Auflage. Vierte Abtheilung. Wirbellose Thiere. Zweite Band. Die Niederen Thiere. Von Dr. OSCAR SCHMIDT. Krebse, Würmer, Weichthiere, Stachelhäuter, polypenartige Thiere, Urthiere. Mit 306 Abbildungen im Text und 10 Tafeln, von JOHANNA SCHMIDT, EMIL SCHMIDT und ROBERT KRETSCHMER. Leipzig, Verlag des Bibliographischen Instituts, 1878. 11 Parts. 40 cents a part, for sale by B. Westermann & Co., New York.

the worms to the Mollusca, the Echinoderms and the Cœlenterates to the Protozoa. While we cannot agree with the learned author in some of his views on classification, the reader may be sure that the volume is a careful and reliable presentation of the more interesting facts regarding these creatures, and which should be the property of every well informed person.

Fig. 1. — *Sacculina carcini.* Natural size.

In those days one can hardly be considered as liberally educated, who is not conversant with the physical theories as to the origin of the different forms of life; and as there are several avenues which lead up to the Vertebrates from the lower animals, no wonder that a knowledge of the lower animals, especially the groups described and figured in this volume, is quite requisite. It should be said, however, that the anticipation of vertebrate characters discoverable in the Ascidians, the Worms and the Molluscs, are recondite, and only appreciable after careful embryological and anatomical studies. This subject is only incidentally referred to by Prof. Schmidt, and perhaps the introduction of too many anatomical cuts and schematic drawings would be considered as out of place in such a work as this.

Fig. 2—*Peltogaster curvatus*; beneath is the larva or nauplius of Parthenopea, magnified 200 times.

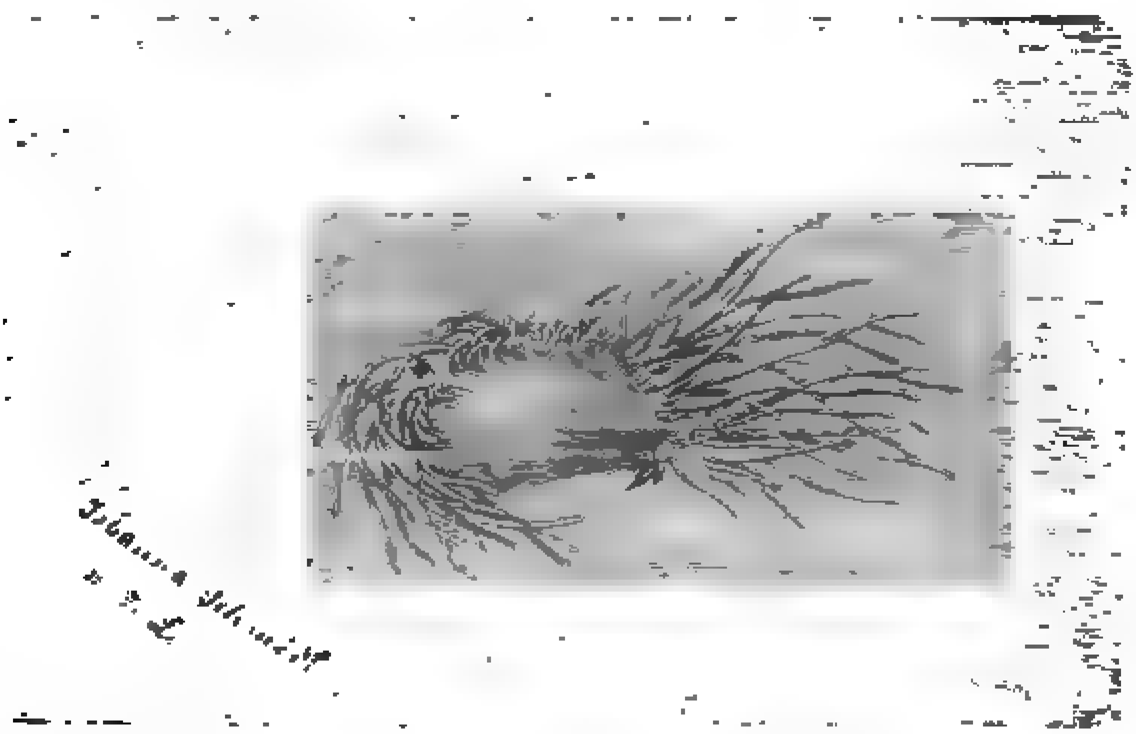

Fig. 3.—Lima flying through the water by opening and shutting its valves.

As it stands, the volume before us is superbly illustrated, and to American students, as we have previously remarked, who may read German with difficulty, the book will be a storehouse of admirable studies from nature of the leading types of animal life.

Many new wood-cuts are added in this second edition; some of these were drawn by Prof. Schmidt's daughter, Johanna, who spent a winter in Dr. Dohrn's Zoölogical Station at Naples, observing and drawing the animals kept alive in the mag-

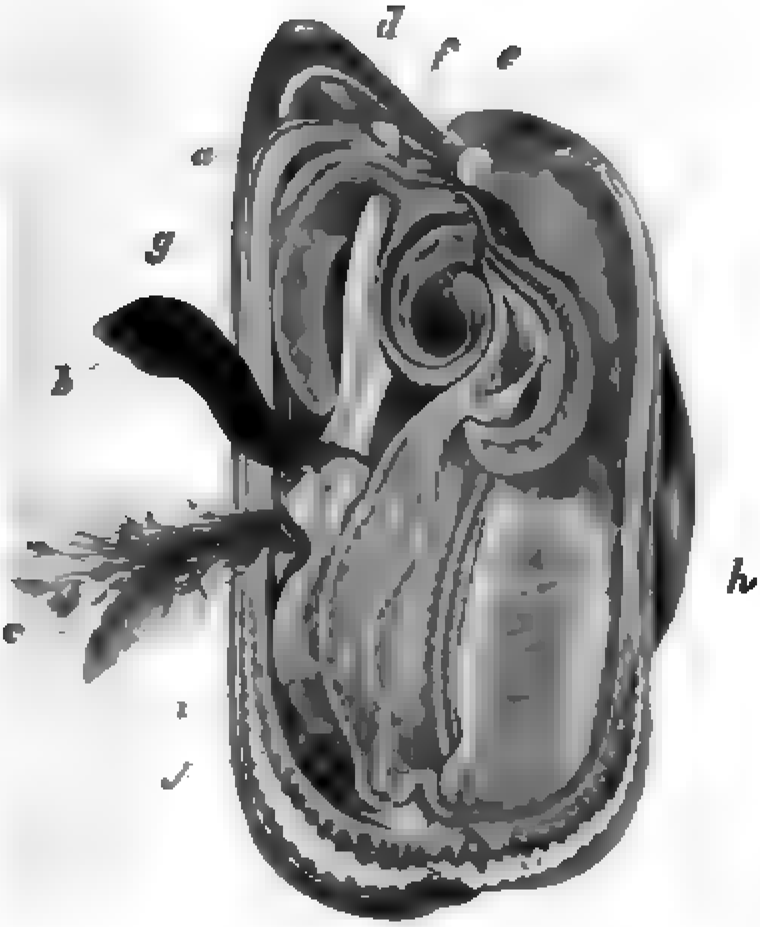

Fig. 4.—Anatomy of the Mussel.

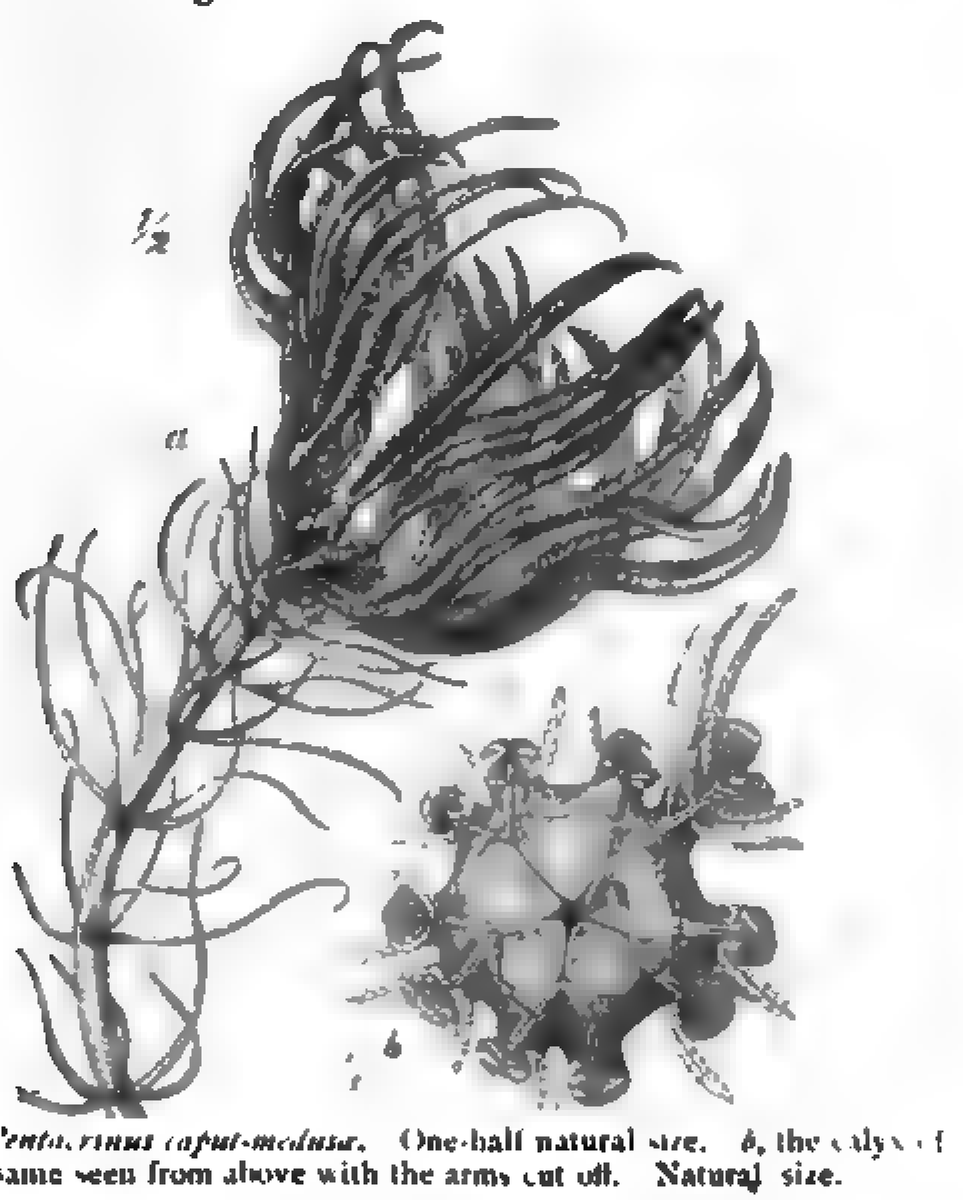

Fig. 5.—*Pentacrinus caput-medusæ.* One-half natural size. *b*, the calyx of the same seen from above with the arms cut off. Natural size.

nificent aquarium of that institution, which has proved such a benefaction and stimulus to working naturalists in Europe. The

FIG. 6.—High Island with barrier and fringing reefs.

FIG. 7.—Coral [illegible]

author has also been aided by Dr. Simroth, well known for his anatomical studies on the invertebrates, especially the Echinoderms.

FIG. 8.—Section through a coral reef.

As an example of the mode of treatment of his subject we may refer to the account of the Hydroid polyps and coral polyps.

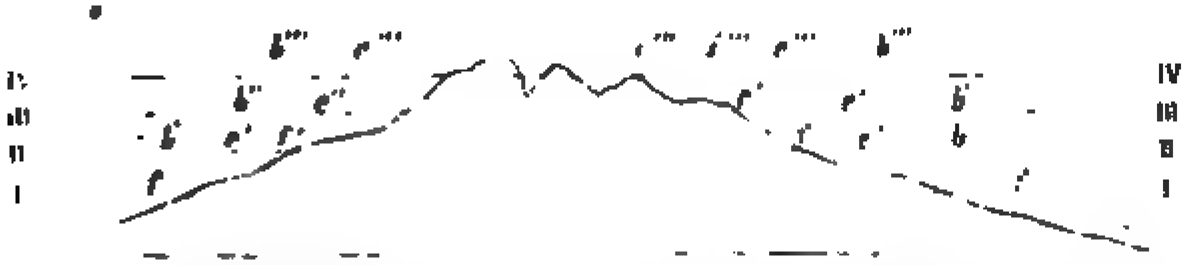

Fig. 9.—Schematic section through an island, indicating the different steps in the formation of an atoll.

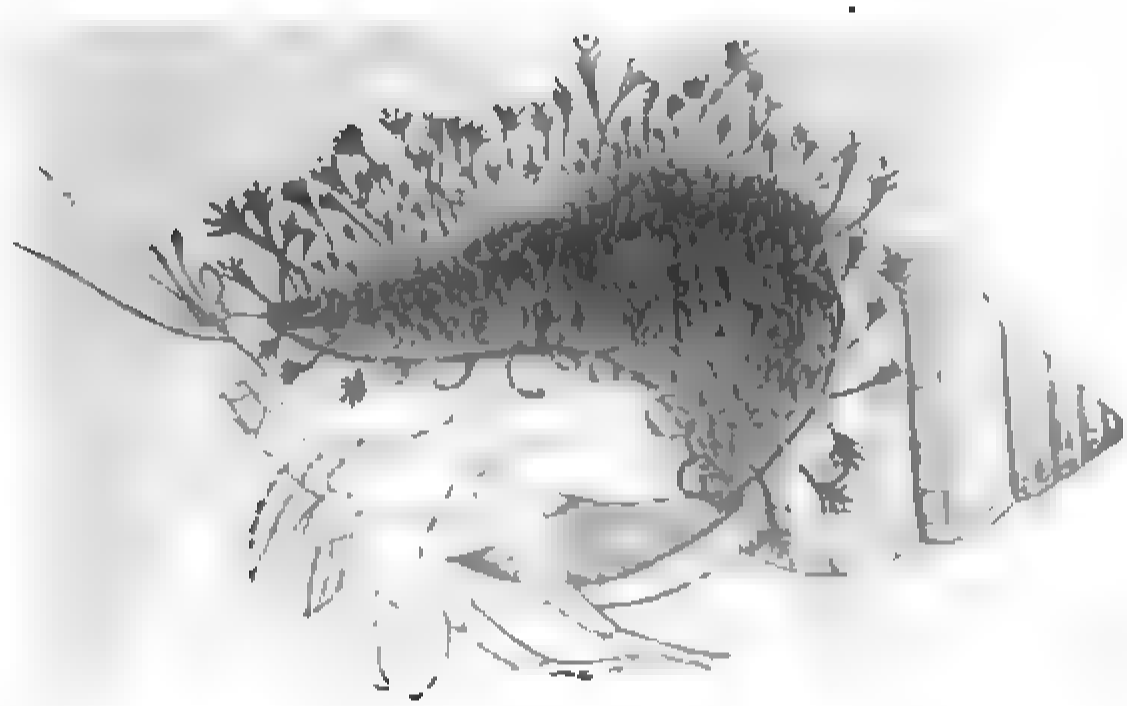

Fig. 10.—Colony of *Hydractinia echinata* on a Buccinum shell inhabited by a hermit crab. Natural size.

The Hydractinia, jelly fishes and other forms that lead up to the Anthozoa or genuine polyps, are discussed, and the latter are fully described, and their mode of development as originally worked out by Lacaze-Duthiers and Haeckel, as well as the that of Halcyonoid polyps and sea-pens. A lengthy chapter is devoted to the subject of coral reefs and coral islands, based on the researches of Darwin, Dana, Ehrenberg and other naturalists. The accompanying illustrations will convey an idea of the mode of pictorial treatment.

Of the full-page illustrations those of the Octopus or Kraken, the paper Nautilus, the group of Holothurians, are especially noteworthy. In conclusion we can only praise in the highest terms this great work, the preparation of which has been entrusted

to some of the best men in Germany, who combine with a thorough

Fig. 11.—Group of a female colony of *Hydractinia echinata*. Enlarged.

special knowledge, the art of setting forth in an interesting and attractive way the history of animal life.

TENTH ANNUAL REPORT OF THE UNITED STATES GEOLOGICAL AND GEOGRAPHICAL SURVEY, F. V. HAYDEN IN CHARGE.[1]—This

[1] *Tenth Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Colorado and parts of adjacent Territories.* Being a Report of progress of the Exploration for the year 1876. By F. V. HAYDEN, U. S. Geologist. Washington, 1878. 8vo, pp. 546, with many maps and plates.

volume is a worthy member of the large series of annual reports of this survey, and is quite as important and rather more fully illustrated than any of its predecessors. The field work reported upon embraced the completion of the explorations known as the Survey of Colorado and portions of adjacent Territories, and was finished in 1876.

The first part, relating to geology, contains a report of Dr. C. A. White on a portion of North-western Colorado, of F. M. Endlich, Geologist of the White River division, of Dr. A. C. Peale, Geologist of the Grand River district, and of W. H. Holmes on the geology of the Sierra Abajo and West San Miguel mountains. These reports are followed by an elaborate essay by Mr. Endlich on the volcanic rocks of Colorado.

The second part, topography, embraces reports by A. D. Wilson on the primary triangulation of Colorado; by Henry Gannett on the arable and pasture lands of Colorado; by G. B. Chittenden on the White River district, and by G. R. Bechler on the Yampa River district.

The third part, archæology and ethnology, is rich in new facts regarding ancient ruins of South-western Colorado, contributed by Mr. W. M. Holmes and Mr. W. H. Jackson. This portion is illustrated by a large number of plates, and is accompanied by essays on the Chaco cranium, and on the Indians of Nevada, California and Arizona, by Dr. W. J. Hoffman.

Part four, palæontology and zoölogy contains an essay by Mr. Lesquereux on the fossil plants secured by the Survey in 1877, and a report by A. S. Packard, Jr., on the insects affecting the cranberry, &c. The maps are in some cases colored, and add greatly to the interest and value of the report.

Fifty of the plates illustrate the remarkable cliff dwellers in southern Colorado and northern New Mexico. A very interesting series of chapters treats of the geology of Colorado, and there is much besides of great interest to the general as well as the scientific reader. Unfortunately, Congress has only ordered the printing of 4,500 copies, and the demand far exceeds the supply.

This Survey has done so much, by its publications, to spread the knowledge both at home and abroad of the remarkable country constituting its field of labor, that every annual report finds an increasing number of readers, and it is not surprising, therefore, to meet with expressions of regret at the want of liberality on the part of Congress in printing too small editions, expressed in our own and foreign scientific journals.

MOSELEY'S STRUCTURE OF THE STYLASTERIDÆ.[1]—It will be remembered that Mr. Moseley substantially set at rest all doubts

[1] *The Croonian Lecture. On the Structure of the Stylasteridæ, a family of Hydroid Stony Corals.* By H. N. MOSELEY, F.R.S. (From the Philosophical Transactions of the Royal Society. Part 1, 1878.) London. 4to, pp. 78, 11 plates.

as to the hydroid nature of Millepora, first suggested by Agassiz and endorsed by Verrill. The present admirable and masterly study certainly proves, beyond doubt, the hydroid nature of the family of beautiful coral-like structures, called from the name of the typical genus (Stylaster) *Stylasteridæ*.

Most of the specimens studied by Mr. Moseley were obtained at a single haul of the dredge aboard the *Challenger*, at a depth of 600 fathoms, off the mouth of the Rio de la Plata, in 1876. It was the examination of this set of specimens which first convinced him that the *Stylasteridæ* were Hydroids and not Anthozoans. The hard and soft parts are described and very fully and beautifully illustrated, the drawings being large and thoroughly intelligible.

As in most all Hydroids, the sexes are on different stocks which have a tendency to grow in a flabellate form with alternate germination. The family is placed with the *Milleporidæ* in a separate sub-order named by Mosely, *Hydrocorallinæ*. This sub-order, its families and genera, are described in full, and an essay is given on the pedigree of the *Hydrocorallinæ*. The author suggests the former existence of a hypothetical *Archistylaster*, and regards *Sporadopora* as "the most ancestral Stylasterid at present known." The essay closes with a short chapter on the distribution in space and time of the *Stylasteridæ*.

Recent Books and Pamphlets.—Report upon the Reptiles and Batrachians collected during the years of 1875, 1876 and 1877, in California, Arizona and Nevada. By Dr. H. C. Yarrow and H. W. Henshaw. Washington, 1878. 8vo, pp. 23.

List of marine Fishes collected on the coast of California, near Santa Barbara, in 1875, with notes. By Dr. H. C. Yarrow and H. W. Henshaw. Washington, 1878. 8vo, pp. 7.

On the fossils called "Granicones;" being a contribution to the histology of the Exo-skeleton in "Reptilia." By Prof. Owen, C.B., F.R.S., etc. (Reprinted from the Journal of the Royal Microscopical Society.) London, 1878. 8vo, pp. 4.

Preliminary Report of the field work of the U. S. Geological and Geographical Survey of the Territories for the season of 1878. By F. V. Hayden. Appendix containing reprints of early papers by the author from the American Journal of Science and Arts. Washington, D. C. 8vo, pp. 29.

A Naturalist in the Magdalen Islands. By Charles B. Cary. (Illustrated.) 8vo, cloth, pp. 93. Boston, 1878. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia, 1878. 8vo, pp. 329–376. From the Society.

The American Journal of Science and Arts, No. 97, Vol. xvii, Jan. 1879. 8vo, pp. 1–92, pls. iii–x. New Haven, J. D. & E. S. Dana, 1879.

The Fossil Insects of the Green River Shales. By Samuel H. Scudder, Cambridge, Mass. (Ext. from the Bulletin of the U. S. Geol. and Geograph. Survey, Vol. iv., No. 4. F. V. Hayden, U. S. Geologist-in-charge.) 8vo, pp. 747–776. Washington, Dec. 11, 1878. From the author.

Hand-book of Alabama; a complete Index to the State, with a geological map and an appendix of useful tables. By Saffold Berney, attorney at law, Mobile, Ala. 8vo, pp. 338. Mobile, 1878. From the author.

Outline of the Geology of Alabama. By Eugene A. Smith, Ph.D., State geologist. (Extracted from Berney's Hand-book.) 8vo, pp. 68, with map. Mobile, 1878. From the author.

On the Mineralogy of Nevada. By W. J. Hoffman, M.D. (Extr. from the Bulletin of the U. S. Geol. and Geograph. Surveys, Vol. 4, No. 3.) Washington, July 29, 1878. From the author.

Scientific Studies; their Place and Use in Education. By T. Nelson Dale, Jr., author of "A study of the Rhætic Strata of the Val di Ledro. 8vo, pp. 23. Poughkeepsie, N. Y., 1878. From the author.

Kupferoxyd-Ammoniak als Oxydations-mittel. Von Oscar Loew. (Separat-Abdruck aus dem Journ. f. Prakt. Chemie, 12mo, pp. 298–302. Leipzig, 1878.) From the author.

Ueber Oxydation des Eiweisses durch den Sauerstoff der Luft. Von Dr. O. Loew. (Separat-Abdruck aus der Zeitschrift f. Biologie.) 8vo, pp. 294–296, 1878. From the author.

The Natural Sciences in Common Schools. By Prof. Jacob Ennis. (Repr. from the Journal of the Franklin Institute, July, 1877.) 8vo, pp. 3. From the author.

On some Dark Shale recently discovered below the Devonian Limestones, at Independence, Iowa; with a notice of its Fossils and Description of New Species. By S. Calvin, Prof. of Geology State University of Iowa. (Ext. from Bulletin of U. S. Geol. and Geograph. Survey, Vol. iv, No. 3.) 8vo, pp. 725–730. Washington, July 29, 1878. From the author.

Studien über fossile Spongien. Dritte Abtheilung; Monactinellidæ, Tetractinellidæ und Calcispongia. Von Karl Alfred Zittel. (Aus den Abhandl. der K. bayer. Akad. der Wissenschaften ii, Cl. xiii, Bd. ii, Abth.) 4to, pp. 48, pls. xi, xii. München, 1878. From the author.

Views of the War Department concerning the Public Surveys of the Territories of the United States; being Appendix NN3 of the Annual Report of the Chief of Engineers for 1878. 8vo, pp. 1661–1666. Washington, 1878. From the Department.

A Monograph of the Silurian Fossils of the Girvan District in Ayrshire, with special reference to those contained in the "Gray Collection." By H. Alleyne Nicholson, M.D., etc., and Robt. Etheridge, Jun., F.G.S. Fasciculus i. (Rhizopoda, Actinozoa, Trilobita.) 8vo, pp. 135, pls. i–ix. W. Blackwood & Sons, Edinburgh and London, MDCCCLXXVIII. From the authors.

Discoveries of the United States Fish Commission: Notices of fifty species of east-coast fishes, many of which are new to the fauna. By G. Brown Goode and Tarleton H. Bean. (Repr. from Am. Journ. of Science and Arts, Vol. xvii, Jan., 1879.) 8vo, pp. 39–48. From the authors.

Description of a new family and genus of Lower Silurian Crustacea. By A. G. Wetherby. (From the Journ. of the Cincinnati Society of Nat. History, Jan., 1879.) 8vo, pp. 4. From the author.

The Distribution of the North American Flora. A Lecture. By Sir Joseph Dalton Hooker, K.C.S.I., Pres. R. S. Delivered on April 12, 1878, before the members of the Royal Institution of Great Britain. (Repr. from the Gardener's Chronicle, Aug., 1878.) 8vo, pp. 8. From the author.

Evolution Evolved; a part of the problem of human life, here and hereafter. Containing a review of Darwin, Huxley and Hæckel. By Wilford. 8vo, pp. 522. Hall & Co., Publishers, 234 Broadway, New York, 1878. From the author.

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GENERAL NOTES.

BOTANY.

A Tree as a Fratricide and Cannibal.—On the bank of the West Nishnabatona river, near Tabor, Iowa, there stands a large sycamore, *Platanus occidentalis*. About ten feet from it is the decayed stump of another of the same species. The diameter of each is about three feet.

Last season, during a freshet, the river ran over its bank past them, uncovering their roots on one side. In this way six different places were shown where large roots from the living tree had become grafted to those of the dead one. For convenience we will designate the dead tree as A, and the living one as B. While in one case the roots of B appear to have met the root of A squarely and followed it, investing it; in other cases the roots from each had crossed each other and grown to a considerable size before uniting. In every case, however, but one root lived beyond the union, and that one belonged to A. In most cases, also, while both lived above the union, that from B was much the larger. In one case that from A had died, leaving the remaining living root joined to B with a curious acute angle in it. One instance was seen of the grafting of two roots from B to each other, in a similar way. A young ash was growing between A and B. It is needless to say that its roots showed no tendency to unite with those around them. Doubtless many similar junctions remained unrevealed. The stump of A was so rotten that it could be easily crumbled with the fingers. Its roots, as before stated, were living some distance above their union with those of B, and doubtless have traitorously carried the nourishment which they helped store in A in its prosperous days, into the root sent out from B, by reversing their action. We may say, therefore, that B has first starved A to death, then by using its own roots as feeders has been devouring it.

This glimpse into the hidden life of trees suggests several interesting inferences:

1. All trees of the same species, in a grove together, may become organically connected. Perhaps this may be turned to their mutual advantage when contending with other kinds.

2. Weaker members of a grove may be killed, not simply by lack of sunshine, air, etc., but they may be literally bled to death by their more powerful neighbors.

3. It is seen how the growth formed by a failure or unsuccessful individual is utilized directly in the economy of nature, just as when in the animal world the large fish live on the little ones.—*J. E. Todd.*

On the Nectar of Flowers.—Mr. Wilson read a paper on this subject before the British Association, which may interest American botanists. He discussed the extent to which the visiting of plants by insects in search of sugar occurs in nature, since this action is believed by some biologists to have been the cause that determined the existence, forms, colors, and odors of flowers. The number of flowers required to yield a pound of honey—viz: two and a half millions—was mentioned as showing what an enormous number of visits an insect collecting honey must make in order to obtain an appreciable quantity, and as proving that the industry of the bee is in reality necessary to its very existence.

BOTANICAL NEWS.—Botanists will be interested in the portion of Sir J. D. Hooker's recent anniversary address as president of the Royal Society of London, which appears in *Nature* for Dec. 5th. He reviews Comte Gaston de Saporta's essay entitled L'Ancienne Végétation Polaire, in which the author takes the ground that life first appeared in the northern circumpolar area of the globe, and that this was the birthplace of the first and of all subsequent floras; the initial conditions of terrestrial life following upon the emergence of the earlier stratified rocks from the Polar ocean.

Among recent botanical works are Heer's History of Vegetation in Switzerland, and Christ's Das Pflanzenleben in der Schweiz.

The forthcoming eleventh report of the U. S. Geological and Geographical Survey of the Territories, in charge of Prof. Hayden, will contain the reports of Sir J. D. Hooker and Prof. Asa Gray on the results of their botanical explorations in the western Territories in connection with this survey.

Trimen's *Journal of Botany* for December contains an article on the pro-embryo of Chara, an essay in morphology, by S. H. Vines.

In the *Bulletin* of the Torrey Botanical Club for November, Dr. Asa Gray records two remarkable forms of Trillium. Mr. C. G. Pringle notices some north-eastern plants; and the discovery of a truffle new to the North American flora, by Mr. W. R. Gerard, is recorded.

A Catalogue of North American Ferns (north of Mexico) in the Davenport Herbarium of the Massachusetts Horticultural Society is to be issued by Mr. George E. Davenport, 8 Hamilton Place, Boston, Mass., provided that he can obtain a sufficient number of subscribers to meet the expense. The price will not exceed fifty cents.

In the *Botanical Gazette* for December, Dr. George Vasey adds to and corrects the catalogue of the forest trees of the United States. Mr. Thomas Meehan writes concerning *Cassia nictitans*. J. R. Lowrie gives a list of the trees and plants inhabiting a plantation which has been protected, for a series of years, both from the inroads of cattle and the labor of farmers.

ZOÖLOGY.[1]

THE BREEDING HABITS OF THE EEL—A CORRECTION.—Farther examinations of additional specimens of the eel, convince me that an error as to the sex of the eel was made in my article in the January NATURALIST. The motile bodies whose active movements misled me were not spermatozoa, but yolk particles, with an unusually marked Brownian motion. The male sex has yet

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

to be discovered. It should be said that the subject is one presenting great difficulties, as formerly stated by Burnett. The spermatic particles of the perch and smelt, are exceedingly minute, about $\frac{1}{10000}$ inch in diameter, and in these we have thus far found it impossible to detect the "tails" with a $\frac{1}{18}$ inch objective.

I have been informed by John Sears, of Danvers, Mass., that he found young eels, somewhat less than an inch in length, with the yolk-sac still attached, at the mouth of a shallow brook running into salt water at Danvers. This was during the month of March; the season was earlier than usual, the ice having broken up in February. This would indicate that the parent eel must have spawned in December. As Mr. Sears is an observing field naturalist, and has noticed the breeding habits of other fish, we suppose him to be correct in the identification of the young eel. We would inquire whether any one else has ever observed eels so young and small as these, and with the yolk-sac still attached.

Mr. Sears informs us, that at Danvers the trout begins to spawn in January, beginning then to make the shallow holes in gravelly places. He has noticed perch spawning in midwinter, in ponds in shallow water, their movements being observed through the ice; at this time the fins become red on the edges. On the other hand, the bream spawns in spring and summer. The horned pout, he says, breeds in holes in the gravel in midsummer.—*A. S. Packard, Jr.*

A Gall-Inhabiting Ant.—The empty dwellings of many animals furnish suitable abodes for others. The abandoned shell upon the beach finds an eager house-hunter in the hermit-crab; shells of Helices are sought by various European mason-bees and wasps as a fitting place in which to build their cells; two species have been found in New England to choose the concave vault of the oak-apple for the same purpose.

I can now record two instances in which galls have been chosen by an ant, *Stenamma gallarum* n. sp., as the home of the colony. The first colony observed was in a gall of *Gelechia gallæ-solidaginis* Riley, upon a dead but unbroken stalk of golden-rod. From pupæ found in this gall on the 31st of May, and placed in a vial under the care of a few workers, there matured three females, one upon each of the following days: June 20th and 23d, and July 7th. The second colony was found while upon an excursion with Mr. K. Mitsikuri, on the 22d of May, 1878, in a fallen gall of *Cynips spongifica* O. S. It was more populous than the other colony, and occupied the central cell, as well as the space between the kernel and the shell of the gall. Except the queen, who was without wings, the community consisted of workers and larvæ only.[1]—*W. H. Patton.*

[1] *Stenamma gallarum* n. sp.

Female.—Yellowish; head, scutellum and petiole above, and incisures of thorax darker; eyes, and spot at insertion of wings, black; the segments of the abdomen with dark-brown borders, the border on the first segment broad. Length, 3 mm.

Dried specimens become darker colored. Three pinned ♀ present the following

A HUMMER'S MEAL.—Mr. A. R. Wallace, in a recent number of the *Fortnightly Review*, says, concerning the tongues of hummers: "This tubular and retractile tongue enables the bird to suck up honey from the nectaries of flowers, and also to capture small insects; but whether the latter pass down the tubes, or are entangled in the fibrous tips and thus drawn back into the gullet, is not known."

Mr. Wallace's remark led to some investigations during the past summer, the results of which do not entirely agree with his statement. Two hummers were attracted to the house by a saucer of syrup placed on the window-sill. Each day they would come and satisfy their hunger. In each instance they would alight on the edge of the saucer, and lap up the syrup as a dog would lap water. The question as to whether insects "pass down the tubes or are entangled in the fibrous tips and are thus drawn back into the gullet," was also solved. Insects too large to pass through these tubes being placed in their way, the birds were observed to take them as readily as smaller ones. The insects were evidently secured by adhesion to the saliva of the tongue-tips, and thence drawn into the gullet. In my opinion, these tubes of the tongue connect with the lungs rather than with the abdomen. These experiments were abruptly terminated, one day, by the approach of a third hummer, a male, who drove the others from the window, and in a fit of rage darted at one of the pair, thrust its bill well through its body, and both fell dead on the ground.—*W. H. Ballou, Evanston, Ill.*

RECENT PAPERS ON CRUSTACEA.—From Mr. W. N. Lockington we have two papers on Crustacea—"Remarks on the Thalassinidea and Astacidea of the Pacific Coast of North America" (*Annals and Magazine of Nat. Hist.*, Oct., 1878), and "On the Porcellanidea of the West Coast of North America" (*ibid.*, Nov., 1878). In the first paper eight Thalassinidea and nine Astacidea are enumerated. One new species (*Gebia rugosa*) is described; *Callianidea typa* is added to our fauna (it was described by Milne

characters: Antennæ 11 jointed, joints 3–7 very short, the 8th joint a little longer, joints 8–10 with a brown annulus. Head, thorax and nodes of the petiole striate, metathorax with two stout spines, first node of the petiole with a short cariniform tooth at base beneath, second node with three very short, blunt teeth in the median line beneath. Body clothed with thinly-scattered, erect hairs; wings white, ciliate; head, thorax, and nodes, light-brown; mandibles, antennæ, and legs, pale yellow, the femora sometimes darker; abdomen, dark-brown; the bases of the segments above and the venter testaceous, the first segment with a broad yellow band at the base.

Worker.—Pale yellow, eyes black, first segment of the abdomen with two dark-brown spots above, which sometimes unite to form a broad band; the spines on metathorax more slender than in the ♀. The second node of the petiole without teeth beneath. Length, 2 mm.

The worker differs from the European *S. westwoodii* in having no spine beneath the second node of the petiole, and the species is easily distinguished by its color.

Connecticut. Inhabiting galls of *Gelechia gallæsolidaginis* Riley, and *Cynips spongifica* O. S., and frequenting the flowers of Violet and Potentilla.

Edwards from New Ireland). In regard to the Genus *Panulirus*, we would say that three of the four species mentioned (*guttatus*, *gracilis* and *americanus*) are East Coast species, and that there is no authority whatever for reporting them from the West Coast. The second paper gives an analytical key and notes upon 16 species of Porcellanidea from the West Coast, nine of which are believed to be new. *Petrolisthes armatus* (Gibbes) Stm. is also credited to the West Coast.

In "Notes on Cladocera," by E. A. Birge (Nov., 1878), we have almost the first systematic contribution to a knowledge of the American forms of this group of Crustacea. Thirty-six species are enumerated, of which twenty, and one variety, are new. A new genus (*Crepidocerus*) of the family *Lynceidæ* is also proposed.—*J. S. Kingsley*.

THE NEBALIAD CRUSTACEA AS TYPES OF A NEW ORDER.—The *Nebaliadæ*, represented by the existing genus *Nebalia*, have generally been considered to form a family of Phyllopod Crustacea. Metschnikoff, who studied the embryology of *Nebalia*, considered it to be a "Phyllopodiform Decapod." Besides the resemblance to the Decapods, there is also a combination of Copepod and Phyllopod characteristics. The type is an instance of a generalized one, and is of high antiquity, having been ushered in during the earliest Silurian Period, when there were, when we regard the relative size of most Crustacea, and especially of living *Nebaliæ*, gigantic forms. Such was *Dithyrocaris*, which must have been over a foot long, the carapace being seven inches long. The modern *Nebalia* is small, about half an inch in length, with the body compressed, the carapace bivalved as in Limnadia, one of the genuine Phyllopods. There is a large rostrum overhanging the head; stalked eyes; and, besides two pairs of antennæ and mouth-parts, eight pairs of leaf-like, short, respiratory feet, which are succeeded by swimming feet. There is no metamorphosis, development being direct.

Of the fossil forms, *Hymenocaris* was regarded by Salter as "the more generalized type." The genera *Peltocaris* and *Discinocaris* characterize the Lower Silurian Period, *Ceratiocaris* the Upper, *Dictyocaris* the Upper Silurian and the lowest Devonian strata, *Dithyrocaris* and *Argus* the Carboniferous Period. Our existing north-eastern species is *Nebalia bipes* (Fabricius), which occurs from Maine to Greenland.

The Nebaliads were the forerunners of the Decapoda, and form, we believe, the type of a distinct order of Crustacea, for which the name *Phyllocarida* is proposed.—*A. S. Packard, Jr.*

CAMPTOLÆMUS LABRADORIUS.—The first specimen of *Camptolæmus labradorius* (pied duck) known to occur in this locality was taken Dec. 12, 1878. It is interesting, as it adds one more species to the list of birds of Chemung county, N. Y., and assists in clear-

ing up the geographical distribution of species. *C. labradorius* is rare everywhere, and its occurrence so far south in the interior gives special interest to the subject.—*W. H. Gregg, M. D., Elmira, Dec.* 14, 1878.

ANTHROPOLOGY.[1]

Anthropological News.—Mr. W. H. Pratt sends us a brochure from the forthcoming part of the Proceedings of the Davenport (Iowa) Academy of Natural Sciences, pp. 156–162, upon the shell-beds in the vicinity of Davenport. They are not regarded as artificial, but were pushed up the bank of the river by moving ice at its breaking up in the spring.

In the *Journal* of the Cincinnati Society of Natural History, Dr. Charles L. Metz describes the pre-historic monuments of the Little Miami valley, embracing all of Columbia and portions of Anderson and Spencer townships. The paper is illustrated by a map in which the remains are indicated by means of the symbols in the Smithsonian circular. As this is the first attempt to use these signs in print in our country, Dr. Metz is to be congratulated on his success, and it is hoped that he will not let his labors cease at this point.

Stephen Barton, of Vidalia, Cal., commences, in the *Iron Age* of that place, a series of letters on the "Early History of Tulare." While it is well to help the local press, it is also a great pity that some of the best aboriginal material ever collected in our country has been lost by publication only in the daily papers; notably the letters of Mr. Taylor, of Mr. Barton's own State.

In the Princeton *Review* of November, Prof. John LeConte discusses man's place in nature. We have seen a notice of a work of 304 pages, by John H. Blake, printed at the Salem press, describing a collection from the Ancient Cemetery at the bay of Chacota, Peru. As we have not seen the work, it is impossible to speak of its merits. The same is true of other anthropological publications; it is hoped that those who wish their works on anthropology noticed in these columns will send a copy to the editor of this department.

In the *Contemporary Review* for November, Mr. F. Lenormant, the distinguished Assyriologist has an article on "Books and monuments bearing upon figured representations of antiquity."

Die Vorgeschichte des nordens nach gleichzeitigen Denkmälern. is the title of a paper in No 43 of *Das Ausland.* In No. 41 of the same journal, is a discussion of the moral relationship between men and animals.

M. D. Kaltbrunner has published at Zurich a work entitled, "Manuel du Voyageur." (Wurster & Co.) Three hundred pages

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

are devoted to anthropology. The work is reviewed in the *Athenæum* for November.

In Mittheilungen der anthropologischen Gesellschaft in Wien, Dr. Moriz Benedikt makes some communications on craniometry. This subject is becoming of great importance, inasmuch as a great deal of the work done is vitiated by the multiplicity of methods employed.

The most important communication which has come to us in the last month, is the paper of Prof. Paul Mantegazza, in No. 2 of *Archivio*, Florence, upon the third molar. The conclusions stated below are based upon the examination of 277 crania, and their description occupies 175 pages:

1. In the lower races the third molar is lacking less frequently than in the higher races, in the proportion of 19.86 per cent. of the former to 42.42 per cent. in the second.

2. The atrophy of the third molar is indeed less frequent in the higher than in the lower, the proportion being 10.90 per cent. of the former to 20.58 of the latter.

3. Ectopia is also a fact observable in all skulls of whatever race, 2.01 per cent. for the higher and 1.80 per cent. for the lower.

4. The same may be said of premature disappearance, 7.22 for the lower races, 7.58 for the higher.

5. Summing up all the cases of abnormality, including those in which there is an absence of the tooth, we find that in the lower races there is about an equal number of abnormal and normal, 50.54 normal, 49.46 abnormal; while in the higher races the abnormality is the rule and the normality the exception, 37.09 normal, 62.91 abnormal.

6. The ancient skulls, as regards the deficiency of the third molar, stand between the lower and higher of modern races. The absence amounts to 27.34 in the hundred, and atrophy to 16.41. On the other hand the premature disappearance is less frequent than in the modern skulls.

7. As to the number of roots in the third molar, there is no relation to the theory of evolution, the teeth examined belonging to lower as well as higher races. It is not true that in individuals of the highest race the number of roots is limited to one or two, while in the lower races the wisdom teeth always have three roots. Indeed the more common fact is this, that in ancient races as well as in the modern, higher or lower, we find the third molar with three roots to be 51.35 per cent. in modern higher races, 45.20 in modern lower races, and 46.43 in the ancient crania.

8. Teeth with four roots are more frequent in the skulls of modern higher races (5.24), after them the modern lower (3.20), and lastly the ancient (2.68). The occurrence of two roots is more frequent in the modern high (23.14), the next in the ancient

(20.53), and in nearly the same proportion is the modern low (20.09).

9. The occurrence of one root is more frequent in the lower modern (31.51), then in the ancient (30.36), and least in the modern high (20.10).

10. I have been able to find in one of the modern higher skulls a rare case—a tooth with five roots.

11. In the lower jaw of all races the third molar nearly always has two roots—91.84 in the modern low, 81.53 in the modern high, and 81.84 in the ancient.

12. I have not found in the modern low, nor in the ancient, a case of a lower third molar with four roots, whilst in the higher it stands 0.597.

13. The occurrence of only one root in the lower third molar is by no means rare, and is found more frequently in the ancient skulls (12.35), less frequently in the modern high (9.38), and most rarely in the modern low (6.12).

14. Cases of the lower third molar having three roots are not lacking, and are more frequently met with in the modern high (8.50), then in the ancient (6.17), and least in the modern low (2.54).

15. That there is witnessed in some cases a lack of one or more of the third molars is an ethnic fact.

16. The dogmatical assertions of Owen upon the number of roots in the negro races and the whites are therefore false, and the morphology of the roots of the third molar has no appreciable connection with evolution.

A remarkable addition to ethnological literature is a revision of Sir Gardiner Wilkinson's "Manners and Customs of the Ancient Egyptians," by Dr. Samuel Birch, and published by Murray, London.

GEOLOGY AND PALÆONTOLOGY.

Extinct Mammalia of Oregon.—A list of *Mammalia* from the Miocene of Oregon was published in the December number of the Naturalist, p. 833. Since that time, Prof. Cope has determined the characters of a number of additional species, some of which are new to science. Two of them belong to a new genus of *Carnivora*, whose cranial form is that of *Putorius* or *Lutra*, and which unites the premolar formula $\frac{3}{3}$ with the two superior tuberculars of *Canis*. It is called *Enhydrocyon*, with two species, *E. stenocephalus* and *E. basilatus*. A remarkable primitive type of *Artiodactyla* combining characters of Ruminants and Suillines with only two metacarpal bones in each foot, is named *Boöcharus*. The only species, *B. humerosus*, is as large as the Indian rhinoceros. A new ruminant is *Poëbrotherium sternbergii*. From the Loup Fork beds are *Lutrictis? lycopotamicus*, and a new species of *Protolabis*, which is named *P. transmontanus*. The article appears in the current number of the Bulletin of the Hayden Survey.

THE NECKS OF THE SAUROPTERYGIA.—It is known that the length of the neck in the Plesiosauroid reptiles of North America diminished in length as the group approached the period of extinction. Thus the longest necks in the order, those of the species of *Elasmosaurus*, are seen in the Niobrara (No. 3) division of the cretaceous. In the Pierre formation (No. 4), we find the shorter-necked *Elasmosauri*, and the *Cimoliasauri* with still shorter necks. In the latest cretaceous (Fox Hills or No. 5), the neck is reduced to its most abbreviated proportions, in the genus *Uronautes*. This shortening of the neck is thus associated with the shallowing of the water, which, as we know, gradually succeeded the deep-sea period of the Niobrara. In Europe the history of the order during the Jurassic period was the same. During the deep-sea epoch of the Lias we have the typical *Plesiosauri* represented by the long-necked *P. dolichodirus;* the shallower Oxford and Kimmeridge seas were the range of the shorter-necked *Muraenosaurus;* while *Pliosaurus*, with the shortest neck, was contemporary with these, and remained as late as the Portland. It is true, that long-necked forms continued as late as the Kimmeridge in England (*Colymbosaurus*). It has yet to be ascertained whether the European cretaceous Sauropterygia present the succession seen in those of North America.—*E. D. Cope.*

THE SCALES OF LIODON.—Professor Snow, of Lawrence, Kansas, has recently observed the scales of the abdominal surface of *Liodon dyspelor*. He states them to be smaller than those of the rattlesnake. Prof. Snow has also obtained a complete fore-limb of this species, and gives a figure of it in the Kansas City *Review of Science and Industry*.

THE FOSSIL INSECTS OF THE GREEN RIVER SHALES.—Mr. S. H. Scudder gives a series of descriptions of the insects obtained from the shales near Green River City, Wyoming, in the 4th volume of the *Bulletin* of the Hayden Survey. They represent the orders as follows: *Hymenoptera*, 4 sp.; *Diptera*, 14; *Coleoptera*, 37; *Hemiptera*, 12; *Orthoptera*, 2; *Neuroptera*, 2; total, 71. Then there are a few species of *Myriapoda* and *Arachnida*. Two new generic types of *Diptera* and one of *Hemiptera* are described.

GEOGRAPHY AND TRAVELS.[1]

THE SWEDISH ARCTIC EXPEDITION.—In the year 1556 Burrough discovered the strait leading into the Kara Sea, between Novaya Zemlya and the island of Waigatz; and in 1580 Pett sailed through the channel which separates Waigatz from the mainland, into the sea, where his further progress was barred by the ice. In 1595 the famous Dutch explorer, Willem Barentz, also reached the entrance to the sea. During the last century the Russians made several attempts to cross the sea, and in 1738 expeditions reached

[1] Edited by ELLIS H. YARNALL, Philadelphia.

the mouths of the Obi, Yenisei, and Pyasina rivers. In 1869 the Norwegian Captains Carlsen and Palliser sailed through the sea of Kara, and since that year the Norwegian fishermen have annually visited it in their pursuit of the seal and the walrus. In 1874 Captain Wiggins sailed from Dundee, and passing through the Waigatz straits, cruised along the Yalmal peninsula, and was able to advance as far as the gulf of Obi. On another voyage, in 1876, reaching the mouth of the Yenisei, he sailed up that stream as far as Kureika, where he left his vessel for the winter and returned overland. His observations demonstrated that the Gulf Stream flows into this sea. While, in July and August, in the same latitudes in Davis' straits and east Greenland, the surface-water is never above 33° to 34°, in the straits of Waigatz the temperature was as high as 50°, and from 48° to 49° in the sea of Kara.[1]

The knowledge thus obtained of the navigability, at certain seasons, of these waters, induced some wealthy Norwegians and Russian merchants to endeavor to open up a route to the mouths of the great rivers Obi and Yenisei, which penetrate some 2,500 miles into the heart of Siberia, and thus provide a new outlet for the mineral wealth of the Ural mountains, the fur and fish of the northern and the produce of the immense forests and agricultural districts of central and southern Siberia.

Mr. Oscar Dickson, of Gothenburg, a munificent and intelligent promoter of Arctic discovery, accordingly fitted out an expedition which sailed from Tromsö in June, 1875, under the command of Prof. Nordenskiöld. This gentleman was already a veteran explorer, having been engaged in six Arctic expeditions (five to Spitzbergen and one to Greenland), made two important spring sledging journeys, and experienced the rigors of a winter north of the 80th parallel, while his scientific attainments were of the highest order. Passing through the Yugor strait and crossing the sea of Kara, he reached a point on the eastern side of the mouth of the Yenisei, which was named Dickson Harbor, from whence he returned homewards.

In 1876 Mr. Dickson, aided by M. Alexander Sibeirakoff, a wealthy Russian, again dispatched Nordenskiöld, who, leaving Tromsö on the 25th of July, after some delays by the ice, again reached the mouth of the Yenisei, and ascended it to Mesenkin, from whence he returned, arriving at Tromsö on the 22d of September.[2]

The success of these two voyages induced Prof. Nordenskiöld to plan his present expedition round Cape Chelyuskin, along the Siberian coast to the straits of Behring. He believed that during September he would find open water all along the coast to Cape Chelyuskin. The rivers Obi, Irtish, and Yenisei send a vast vol-

[1] See *Geographical Magazine*, March, 1877.
[2] Petermann's *Mittheilungen*, 1877, Part II., p. 54.

ume of warm water into the ocean in the month of August, which would, from the effect of the rotation of the earth exercised on streams running north or south in high latitudes, be driven to the eastward, and open a channel along the coast.

Heretofore no vessel has succeeded in doubling Cape Chelyuskin. Between the years 1735 and 1740, the expeditions sent out by the Russian government surveyed portions of the coast, and their vessels reached the mouths of the Pyasina on the west, and of the Khatanga on the east side of Cape Chelyuskin; but it was not until 1742 that Mate Chelyuskin discovered the northernmost point of Asia when on a sledge journey. From the Lena to Behring's straits more is known of the coast, but the expeditions were made in small sailing vessels, and passed over, in most cases, but small portions of the coast line. In 1728 Behring visited the straits now called after him; in 1770 the New Siberian islands were discovered; and in 1778 Captain Cook reached the 180th degree of longitude. Our best accounts of this region are derived from the explorations of the Russian Admirals Wrangell and Anjou, in 1820, '21, '22, and '23. Kellett Land and Herald island were discovered by the British in 1849, and in 1855 the United States expedition under Captain, now Admiral, Rodgers, reached the 176th degree of longitude. In 1867 Captain Long, in an American whaling vessel, got as far as 170° E.

At present, says the *Geographical Magazine*, August, 1878, we have no knowledge of the vegetable and animal life (consisting of survivals from the glacial period) in the sea which washes the north coast of Siberia, yet a complete and certain knowledge of what animal types are of glacial and what of Atlantic origin, is of the greatest importance, not only for zoölogy and for a knowledge of the geographical distribution of animals, but also as regards the geology of Scandinavia. Our knowledge of the animal and vegetable types which lived at the same time with the mammoth is exceedingly incomplete.[1]

Influenced by all these considerations, the Swedish government and the King and M. Sibeirakoff together contributed £8,000, to which Mr. Dickson added £12,000, to fit out the present expedition. The *Vega*, a very strong steamer of 300 tons, was purchased, and supplied with from two to three years' provisions, coal sufficient to steam 8,000 nautical miles, and a steam launch. The names of the officers of the *Vega* are: Prof. Nordenskiöld; Captain Pallander, commander (who has had much experience in Arctic voyages); Doctors Kjellmann, Stuxberg, and Almgvist, Scientific staff; Lieut. Hovgaard, Danish Navy; Lieut. Brusevitz, Swedish Navy; Lieut. Bove, Italian Navy; and Lieut. Nordgvist, a Finnish officer and geologist. The crew consists of eighteen seamen and three hunters.

The *Vega* departed from Tromsö July 21, 1878, and arrived at

[1] See also Petermann's *Mittheilungen*, 1878, Part 2, p. 67.

Habarowa, a Russian hunting-place in the Yugor straits, on the 30th. She was accompanied by a small steamer, the *Lena*, and also by the steamer *Fraser*, having a sailing vessel, the *Express*, all employed by M. Sibeirakoff, to open maritime commerce with Siberia. During their short stay here collections were made of the fauna of the sea and the flora of the land. Many specimens of fish were obtained, and special attention devoted to the morphology and development of the phænogamous plants. Habarowa is inhabited in the summer by nine Russians, who live in wooden, turf-covered cabins, while the native Samœides have tents of reindeer skin. Dr. Nordenskiöld purchased some of the native costumes, and, after some difficulty, specimens of their "gods." These objects of veneration resemble the rude rag dolls of children, and are of stone or wood, dressed in fur and fine rags, with pearl ornaments. Sacrifices of bears, reindeers, etc., are made.

The island of Waigatz is a plateau about 90 kilometres long by 40 broad. The Silurian and limestone beds contain many fossils. Leaving Habarowa on the first of August, the *Vega* sailed slowly (to allow time for dredging) across the Karian sea, while the *Lena* was sent to examine the Beli strait, which separates White island from the Yalmal peninsula. Some fields of rotten ice were encountered but fog proved the only hindrance, and they reached Dickson Harbor on the 6th of August. Prof. Nordenskiöld speaks of this harbor as safe and commodious, and as promising to become the chief port for the export of Siberian products. In geological formation, the land resembles Spitzbergen. In consequence of the inferior saltness of the water, there is little animal life. Three white bears were shot.[1]

After a careful survey of Dickson Harbor, and adding to her supplies the coal and provisions brought so far by the *Express*, the *Vega*, still accompanied by the *Lena*, continued her voyage on the 10th. Further information of the expedition is given in a letter of Prof. Nordenskiöld's in the *New York Herald*, and in accounts in various European journals. On the 11th of August they passed Cape Sterlegoff, the furthest point ever reached by a vessel. They soon perceived the charts to be entirely wrong, the coast being far more to the west than supposed, and numerous islands not given were met. The fog caused much embarrassment, but the ice did not often give them much trouble. The saltness of the water increased and the temperature fell, while the organic life at the sea-bottom became richer, and fine specimens of the remarkable crinoid *Alecto eschrichtii*, starfish, and large ocean Algæ were obtained. On shore the higher fauna and flora were very poor. Snow sparrows, several species of wading birds, and some varieties of geese were found. Occasionally scenes of great beauty were presented when the sea was smooth and clear; the

[1] See Prof. Nordenskiöld's letter from Dickson's Harbor in Petermann's *Mittheilungen*, 1878, Part xi, p. 430. Also letter of Lieut. Hovgaard's, from same place, in *Verhandlungen der Gesellschaft für Erdkunde zu Berlin*, 1878, p. 198.

midnight sun hung low over the horizon, and to the south the Taimyr land glittered fiery red in its rays, while the cliffs and castles of ice stood colored blue, purple, crimson, and silver-white. Over this scene lay a stillness which sent a man's voice miles and miles away, and the scratch of the bears walking over the ice-blocks was heard afar off. Waiting for clear weather, they lay at anchor, from the 14th to the 18th, in a small bay in the sound between the island of Taimyr and the continent. This haven was named Actinia Port, and would be a favorable position for one of Weyprecht's proposed meteorological stations. The land here was free from snow, and covered with a gray-green carpet of grass, mosses, and lichens. On the 18th, the fog still continuing, they set sail, and in spite of fog and some large masses of ice, passed Cape Chelyuskin on the 19th, with flags waving and guns firing a salute. Cape Chelyuskin is a low promontory, divided into two parts by the bay in which the vessels anchored. The west cape is in 77° 36′ 37″ N. lat. and 103° 25′ 5″ E. long., and the east cape is in N. lat. 77° 41′ and E. long. 104° 1′. Inland the coast gradually rises to about 1,000 feet. This hill, as well as the lowland, was almost free from ice. The ground appeared to be mainly clay, curiously cracked, and covered with moss, lichens, etc. The formation here were perpendicular strata of slate, with no fossils, but rich in crystals of sulphide of iron, and at one point traversed by large veins of quartz. Both animal and vegetable life were exceedingly poor and the former very tame. In the sea also the higher forms of life were scarce, but large Algæ and a large number of lower animals were obtained. On the 20th they weighed anchor, when drift ice was soon met with. After being obliged to sail in a northern and north-western direction they escaped, and the north-eastern extremity of the Taimyr peninsula (76° 30′ N. lat. and about 113° E. long.) was sighted. The coast is about fifty miles more to the west than noted on the charts. Here they found almost open water. It was observed that the bergs encountered were of fresh-water formation, indicating the existence of hilly islands to the north. Mountains of 2,000 to 3,000 feet in height were seen some distance away from the coast. There was now a great increase in marine animal life, all of pure arctic types. The island of Preobashenskoi was reached on the 24th, and found to have been laid down sixty miles too far west. From here eastward to the Lena an ice-free and comparatively warm sea was met with.

Arriving at the mouth of the Lena the two vessels parted company, and the *Vega* continued on her way, while the *Lena* ascended the river to Yakutsk, arriving there on the 21st of September.

As no further account of the former has been received, she is no doubt passing the winter in the ice, perhaps near the East cape, where Captain Campbell, of the steamer *Norman*, from

St. Lawrence bay, October 20, 1878, reports that the natives have seen a vessel.

So far this has been one of the most successful and important of modern exploring voyages. The chart of the voyage is published in the *Mittheilungen* for January, and is of great interest to geographers, as so many corrections have been made in the coast-line of the northern shores of Asia.

The discovery by the Norwegian Captain E. Johannsen, of a small island in long. 81° E. and lat. 77° 55′ N., was made on the 3d of September last. He named it "*Ensomhaaten*" (Loneliness). The sea was open in every direction round it except to the southeast, where drift-ice was to be seen.

Already commerce has sprung up on the new route, and during the last season vessels were sent out from English, German, and Norwegian ports, and made more or less successful voyages to the Ob and Yenisei and back.

MICROSCOPY.[1]

NUCLEATED RED CORPUSCLES OF HUMAN BLOOD.—Many of the readers of the AMERICAN NATURALIST are familiar with the little instrument generally known as Beck's Vertical Illuminator, it is in fact a modification of a device invented by Prof. H. L. Smith, of Geneva, N. Y.

This illuminator was originally intended to be used in conjunction with medium power, dry objectives, of moderate angles, such as were formerly so much in vogue. Mr. Morehouse, a well known microscopist of Wayland, New York, fortunately discovered that by the conjoint use of the illuminator with immersion objectives of high balsam apertures, astonishing results might be secured, as for instance the resolution of the markings of podura and other insect scales, the striation of valves of *Frustulia saxonica*, *Surirella gemma* and similar "difficult" diatoms, under amplifications of 3000 and 4000 diameters, and as a matter of course, by reflected light.

Mr. Morehouse promptly informed me of his results, and I immediately repeated his experiments, and with perfect success; I also devised a modification, consisting of an adjustable shutter, regulating the admission of light, thus greatly improving the brilliancy of the objects, accompanied with marked increase of resolving power, and with the instrument thus modified I had no difficulty in obtaining beautiful displays of the Nobert 19th band, the simultaneous exhibition of the long and transverse striæ of *Frustulia saxonica*, etc., under powers of three and four thousand diameters.

Desiring to test the vertical illuminator over histological preparations, I thus examined a slide of human blood, improvised for the occasion, and was astonished to find about three-fourths of

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

the red corpuscles nucleated, the amplification employed in these observations was about 3700 diameters.

My observations with the vertical illuminator as above related, were presented to the Dunkirk Microscopical Society in a paper which I had the honor to read before that society some two years ago, on which occasion many of the observations were publicly repeated, since which date similar results, as to the nucleus of the red corpuscles, have been arrived at by others, but as far as I can learn, these later observers subject the blood to treatment by means of re-agents, etc., the direct observations, therefore, as obtained with the vertical illuminator are to be preferred.

A point which should not be lost sight of is this, the vertical illuminator can only be successfully used in conjunction with an objective of high balsam angle; and may it not be further suggested that the use of wide angled glasses is not to be confined to the work of the diatomist?—*J. Edwards Smith, M.D., Cleveland, Ohio, Dec.*, 1878.

THE WENHAM COMPRESSORIUM. — Mr. Geo. O. Mitchell, of Hanover, N. H., is making this useful little accessory of a somewhat smaller size than usual, and at a less price. His instruments have been furnished to several colleges and to experienced workers with the microscope. They are well made, and are sent by mail for $1.50, or nickel-plated for $1.75.

EXCHANGES. — Frank S. Collins, 26 Tremont street, Boston, Mass., would like to exchange New England for California, Florida and other Algæ.

——:o:——

SCIENTIFIC NEWS.

— Dr. Albert Günther, director of the zoölogical department of the British Museum, has received the gold medal of the Royal Society for his important researches on the zoölogy and anatomy of the fishes and reptiles.

— The *Polytechnic Review* of Dec. 21, states that "Prof. J. Gibbons Hunt, of New York, one of the most accomplished microscopists in the country, says that it is affectation or stupidity for Americans to send to Europe for microscopes when they can now purchase better ones at home." It will surprise Dr. Hunt's friends to learn that he is "of New York," especially since the editor of the "*Review*" is, like Dr. Hunt, a citizen of Philadelphia.

— We learn that the Princeton Geological and Palæontological party met with excellent success during the past season. They visited the region of the Mammoth Buttes, east of the Green river, in southern Wyoming, which was explored by Prof. Cope in 1872, and obtained fine series of *Loxolophodon cornutus*, *Palæosyops vallidens* and other species. They will be able to furnish much additional information as to the structure of these

animals. They also examined the region of the upper Ham's Fork, and visited the fish-bearing shales of the tributaries of Bear river, obtaining a good representation of the fossils of that region.

— Longmans & Co. have just published a translation of Heer's The Primæval World of Switzerland. Edited by James Heywood. An excellent book for boys with a love of insects is Candèze's The Curious Adventures of a Field Cricket. The illustrations and style are most inviting. Dr. Ernest Candèze has long been known as a Belgian coleopterist of high reputation. Petermann's Mittheilungen, will hereafter be edited by Dr. E. Behm, assisted by Dr. Lindeman.

— Etna: a history of the mountain and of its eruptions, by G. F. Rodnell; with maps and illustrations, London (C. Kegan Paul & Co.), is said to be an excellent and most interesting monograph, comparing favorably with Prof. Phillips' work on Vesuvius.

— The death of George Henry Lewes was quite as much a loss to biology as it was to literature and philosophy. His Seaside Studies is one of the most readable of such books, and in literary merit far out-weighs any similar works; besides it is critical from the point of view of comparative anatomy and physiology. What a hold the biological methods of inquiry have gained among philosophic thinkers is evinced by the reception accorded to Lewes' last and greatest work, the Problems of Life and Mind, however much one may refuse to endorse all the conclusions of its author.

— A new edition of Prof. Ramsay's Physical Geology and Geography of Great Britain is occupying the attention of reviewers in British journals. His American friends will be pained to know that late in the autumn Prof. Ramsay suffered the extirpation of an eye.

— Prof. Tyndall has just communicated to the Royal Society the results of some further observations on infusions boiled in flasks afterwards hermetically sealed. He took with him to the Alps, last summer, one hundred tubes of infusions—fifty containing turnip and fifty containing cucumber infusions. They were prepared at the laboratory of the Royal Institution, and boiled for five minutes. Twenty flasks were broken in transit. The eighty remained pellucid, and the twenty were turbid with organisms. A number of the eighty flasks had their ends opened in air in which saw-dust had been shaken up, and all were soon turbid. Another set were infected by water of a cascade derived from melting snow, and in three days were thickly charged with organisms. Another set were opened in pure air and remained transparent.

— The curious discovery, says the *English Mechanic*, of parasitism on a diatom (*Pinnularia*) has recently been made by a

Frenchman, who observed small brown points on the surface of the diatom, which have extraordinary agility, and by means of their long flexible appendices explore all parts of the frustule.

— Herr Naumann, a German geologist in Japan, has lately published a work on the earthquakes and volcanic eruptions of Japan. Mr. V. Ball publishes, in the *Geological Magazine* for January, an illustrated article on the volcanoes of the bay of Bengal, correcting some current errors in regard to them.

— We have had an opportunity of examining some excellent photographs by Mr. Franklin C. Hill, of Princeton, New Jersey, illustrating the external anatomy of *Harpalus caliginosus* and *Lucanus cervus*; they are about six inches long. Each appendage and joint, as well as the veins of the wings and the different parts of the body are labeled, so that they are excellent diagrams for the beginner in entomology. The upper and under side of the body is represented, there being four photographs in all, at fifty cents each.

— A writer in *Scribner's Monthly* refers to the protective coloration of the Caribou, stating that the quiet gray color is well adapted to conceal its presence from the hunter, and that it requires an educated eye to pick out its form on the heathy barren where everything assimilates to it in color. "The Indians are so well aware of this, that they always approach a barren with extreme caution, always traveling down wind, and never disconcerted if game is not sighted at once. Nor is the case improved when one comes to hunt for them in the forest; there, the gray tree-trunks and tangled undergrowth make it extremely difficult to see them."

— M. Charles Barrois, of Lille, France, the author of the elaborate treatise on sponges, which appeared two years since, is now in this country studying the geology of the United States east of the plains. Hereafter M. Barrois will devote himself to palæontology and geology, while his brother, M. J. Barrois, the author of the exquisite works on the embryology of nemertean worms and Polyzoa, will continue his zoölogical studies.

— We regret to notice the suspension of *Field and Forest*, edited by Charles R. Dodge. It was the bulletin of the Potomac-side Naturalists' Club. The number for April, May and June, only lately received, closes volume third, and contains an index.

— Mr. Xenos Clark, of San Francisco, writes us that he is endeavoring to establish a Biological Laboratory at or near that city. Such an institution would be most desirable, and it is to be hoped will meet with liberal support.

— The museum of Brown University has secured through the generosity of the Senior Class of 1878, the skin of a Baffin's Bay walrus, which has been admirably mounted by Professor Jenks, and is now on exhibition.

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REMARKS ON FOSSIL SHELLS FROM THE COLORADO DESERT.[1]

BY ROBERT E. C. STEARNS.

A LUMP of earth from the Colorado Desert which it is here proposed to investigate, is not without interest. It is part of a much larger piece recently brought from Walter's station, a point on the Southern Pacific railroad, in California, where it was selected by Prof. Geo. Davidson, who has furnished the special facts as to locality.

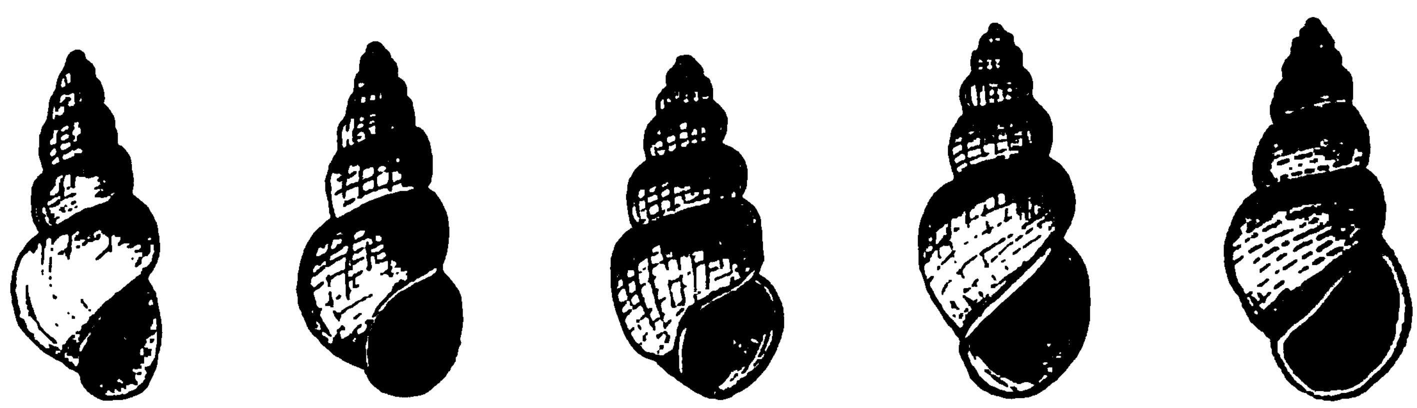
It is composed of clayey sediment, and was brought to the surface, from near the bottom of a well recently sunk by the railroad company at the above named place, during the process of digging through the dry deposit in a forty-inch tubing (an old smokestack). At forty-five to forty-seven feet the water-bearing stratum was struck, when the water burst up and filled the tube to within twelve feet of the surface. The continuous pumping out of a two and a-half inch stream does not lower the water line in the well. The lump, it will be noticed, contains many small shells. The larger portion of the original piece readily dissolved in hot water, in which it at once separated. Thinking it might contain diatoms or other minute microscopic forms, some of it was examined by Dr. A. M. Edwards, without, however, any being detected. The shells, though small, are easily seen without a lens, are all fresh-water forms and are also found

[1] Read before the California Academy of Sciences.

in great numbers (sometimes in windrows) at various places on the surface of the desert.

Physa humerosa Gould. Natural size.

One of the species from the well is *Physa humerosa* Gould, of which there is a single specimen; the others, of which there are numerous examples, are *Tryonia clathrata* Stimpson, and *Tryonia protea* of Gould. These latter belong to the family of *Rissoidæ*, and were described several years ago from specimens collected by Prof. Wm. P. Blake. They have also been collected by several other parties. From the late lamented Col. Albert S. Evans,[1] I received, several years ago, half a pint of these desert shells, and from others I have received a great number; probably altogether as many as 40,000 specimens have passed under my inspection, including the above and a single species of *Amnicola* (*longinqua* Gould), as well as fragments of a *Planorbis* and of *Anodonta californiensis* Lea. It is not unlikely that if we had a sufficient quan-



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Tryonia protea and varieties (semi-fossil). Colorado Desert, Cal. From nature, by Stearns.

tity of sediment from the well, we should find that it contained all of these forms. All of the great number of specimens which passed under my observation, are in a fossilized or semi-fossilized condition, either of a clear opaque white (in this respect resembling the fossils of the Paris basin), or more or less translucent, though more or less silicified, while the delicate sculpture is as perfect as ever.

The surface of the desert at the point where the well is situated is 195.54 feet below the level of the ocean, as indicated by the

[1] Col. Evans was lost at sea, while on his way from New York to Brazil, by the burning of the steamship *Missouri* off the Bermudas.

barometer. Shall we indulge in a guess as to the depth of the water when these shells were alive; shall we add the depth of the well to the above figures, and again add the elevation of bench-marks, the ancient levels[1] which form terrace lines in some places along the distant hills, once a part of the shores of a now extinct lake, the walls of the basin which once enclosed and held a fresh-water sea?

It may have been, however, that the lake was never as deep as the figures thus added would indicate, and that instead of a lake or series of lakes, there existed only a lagoon or chain of lagoons, connected or disconnected, according to the volume of water, which probably varied one season compared with another; a system of shallow reservoirs, receiving the catchment or surplus surface water in periods or seasons of unusual rainfall; sometimes after a prolonged and widespread storm of great severity, uniting and forming an extensive expanse a few feet only in depth, as was seen in the valleys of California during the notable winter of 1861–2.

The rate of depression may have been such as to continue to keep the lagoons supplied during ordinary seasons with catchment or surface water from the immediate neighborhood, and have been so proportioned (involving the mean of supply) to the rate of evaporation, that only within a very recent period has this depressed portion of the Colorado basin become bare and dry.

Are the phenomena which this vast and remarkable region exhibits—of which that portion usually called the desert, is but a part—the result of catastrophic action, sudden, violent and widespread, or the result of gradual changes moving slowly through countless centuries?

The physiognomy of the wider and more general region in some of its aspects indicates action which, in geologic time is unmistakably recent, and the varied phenomena here exhibited, are more likely the result of periods of slow movement as well

[1] For miles and miles I traced with the eye a strange, well-defined line along the mountain sides, always at the same level * * * Riding out to it I found it to be the old beach of a sea.

The rocks were worn and rounded up to that level, * * * above that line the rocks were sharp and jagged. The surveying party of the Southern Pacific railroad, in running the line to Fort Yuma, struck the present sea-level the moment their instruments reached this ancient beach.—*Dr. J. P. Widney in Overland Monthly, Vol. x, 1873.*

as periods of convulsive action, recurring cycles of sudden and of gradual changes, operating through different but succeeding geologic ages or periods of geologic time. Prof. Whitney has pointed out the coincidence of mountain peaks of extraordinary elevation and areas of extraordinary depression (below the sea level), which are a part of the peculiar characteristics and striking topographical features of the same general area.[1]

During the pliocene epoch the site of the present desert was occupied by the sea or was, perhaps, a part of the Gulf of California.

"Beds of * * * Miocene and possibly Pliocene fossils are found at the mouth of Kern River cañon, showing that the sea then washed freely against the foot of the Sierra ; there is even reason for believing that it extended far up the Colorado River basin; and certainly it deposited a thick bed of the enormous Miocene oyster (*O. titan*), with other remains along the west shore

[1] For most interesting information as to the height of mountains, the depression of Death and other valleys, saline plains, alkaline lakes, mud volcanoes and other phenomena which mark the physiognomy and relate to the general aspect of this wonderful region, attention is directed to Vol. i, Geol. Survey of Cal. (by Prof. Whitney), also Whitney in Proc. Cal. Acad., Vols. ii, iii and iv; Veitch in Vol. i, *id.*; Col. Williamson in Vol. iii, *id.*; Cooper in Vol. v, *id.*, and Lieut. Wheeler's Annual Report for 1876. Another author, Dr. J. P. Widney, from whose interesting article in the *Overland Monthly* (January, 1873) I have previously quoted, writes as follows of the Colorado Desert.

Crossing by the San Gorgonio Pass, the continuation of the Sierra Nevada range back of San Bernardino, the traveler leaves the fertile coast valleys [of California] and enters upon what appears * * * * the * * remains of some ancient world. As he came through the * * pass, upon his right towered San Gorgonio Peak, * * 10,500 feet in height. Upon the left forming the other wall of the pass, pine-clad San Bernardino * * reaches an altitude of 11,500 feet. But leaving now the mountains behind he descends into what seems the scorched, blasted bed of some old cyclopean furnace * * * San Gorgonio and San Bernardino on this side have lost their pines, and brown, barren and desolate, frown down upon yet greater desolation. Upon the west * * * stretch the Sierra in an unending line—a forbidding rugged wall. At the north, a spur from this main chain turns off eastward, and then curving around bears to the south, parallel to the Sierra, making another abrupt wall, which at last drops down and is lost near Fort Yuma. Inclosed by these mountains, open only toward the south, where 200 miles away it faces out upon the waters of the Gulf of California, is the Colorado Desert.

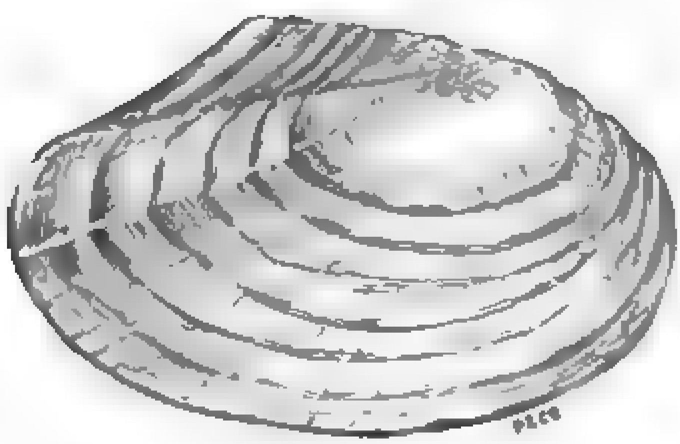
Surrounded upon every side by mountains, except in one direction, and there opening out upon the head of the Gulf of California; it shows that the desert is a portion of the old gulf which then extended 200 miles above its present limit. The cause of the separation of the upper end of that gulf, making what is now the Colorado Desert, is so apparent, that a moment's examination reveals it. The same

of the present Colorado desert, now at an elevation of probably 1000 feet."[1]

The sedimentary deposits super-imposed upon the more ancient sea or gulf bed, the top of which now constitutes the floor of the desert are geologically of very recent origin.

The perpendicular section of nearly fifty feet cut by this well, as shown by the character of the stratum cut through in connection with the shells contained therein, indicates a gradual deposit, a slow settling of sediment; the fragility of the shells and their present unfractured condition, prove that they were never subjected to abrasive action; that they were not swept violently from distant places to this, and here buried pell-mell beneath and among the varied detritus of great freshets.

Here probably was the home of *some* of these species, the metropolis of *Tryonia*, if not its specific center, which has only been



Anodonta californiensis Lea. Rio Colorado, Cal.

found sparingly elsewhere, and was supposed to be extinct. Ninety per cent., if not more, of the shells found here belong to this genus.

agency is still at work, widening the space between the Gulf and the desert. Here nearly 150 miles from the head of the ancient gulf came in from the east side the Colorado River, bearing in its thick floods, quicksands and the red mud from the great plateaus of northern Arizona which gives the river its color and its name. The contour of the country shows the gulf to have been narrow here. The filling in of this alluvial deposit went on unceasingly, as at the mouth of every great river which enters the sea at a sheltered point. The water grew constantly shoaler, until at length the separation was complete. The alluvial deposit has steadily increased the distance between the gulf and the low bed of the desert, until now the division is marked by a narrow neck of thirty or forty miles of land but little raised above the sea level. (Dr. Widney, in *Overland Monthly*, Vol. x. See also various papers on Arizona, &c., and the Colorado river, in Vols. iv, vi, and ix, *id.*)

[1] Cooper in Proc. Cal. Acad. Sci., Vol. v, p. 403.

Mr. Tryon reporting on certain shells collected by Lieut. Wheeler's expedition in Utah Territory, says,

"Included in the collection are two specimens of the genus *Tryonia* Stimpson. This curious little genus was heretofore considered to be restricted to the Colorado Desert of southern California. * * Two species have been described, viz: the type *T.* (*Melania*) *exigua* Conrad, of which *Melania protea* Gould is a synonym, and *Tryonia clathrata* Stimpson. The two Utah specimens are probably *T. exigua*."[1]

The lump of earth from which the specimens mentioned were obtained was about the size of one's fist, yet this comparatively small matrix contained as many as three hundred. What an inconceivable number must have been propagated and buried here, what numberless generations have been born and died, since the lowest foot in this perpendicular well-section was deposited, to the last and most recent deposit, when the present surface was reached and completed! If the mind is unable to comprehend what is equally imperceptible to the eye, the numbers buried *beneath* the surface, the mind also fails to comprehend what *is* visible to the eye, the vast number which are seen *on* the surface of the desert in crossing it, the external skeletons of the vast multitude left on the top of the last deposit, when the last inch of water evaporated and left a sterile and windswept waste, upon which to-day are scattered untold millions of these tiny forms.

If we may assume that the species to which these forms belong no longer exist, within the more special area under consideration, they must have become extinct within geologically a very recent time. An examination shows the sculpture to be wonderfully sharp and well defined, yet probably the life of these minute organisms, that is to say, the specific life, had an earlier genesis than that of the human race, and the particular specimens before us were living, at a time, prior to the appearance of man on the planet.

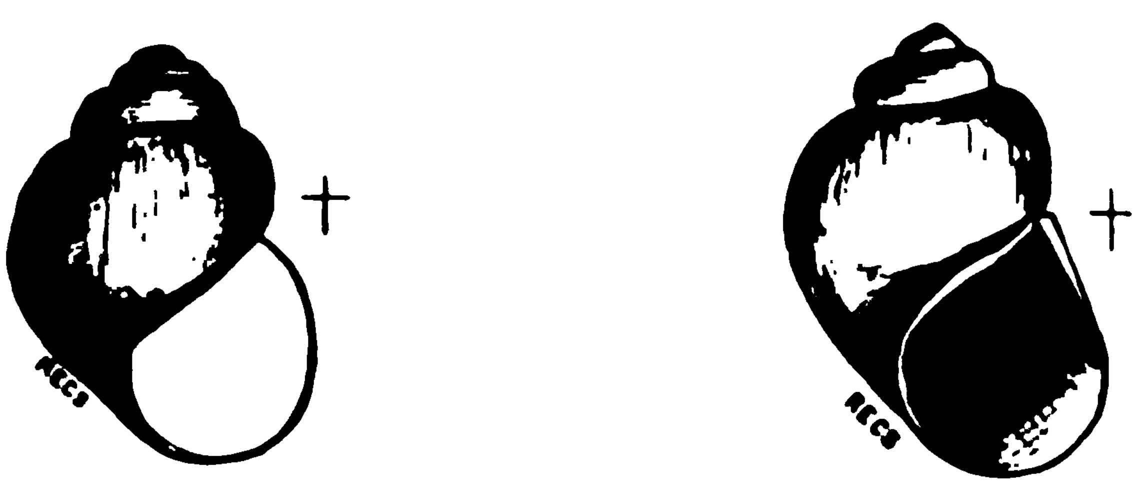
We have here also an illustration of the relation of life and species to environment, as shown in the extinction of the former, through a radical change in the latter.

In connection with the total evaporation of the former lake or lagoons as above, it should not be inferred therefrom that the particular portion of the desert incidentally under consideration,

[1] Proc. Phil. Acad. Nat. Sciences, May 1, 1873.

has been permanently and continuously dry ever since the extinction of *Tryonia*, but that through evaporation, *it ceased to be permanently covered* with water, and though since at various times, a greater or less area has been so covered—the extinction of *Tryonia* proves that there must have been a period of drouth, a maximum both as regards degree and duration which destroyed the limited fauna, the few species which once existed here—though some of the species which I have named belonging to the genera, *Anodonta*, *Physa*, and *Planorbis*, having an earlier genesis, are known to have a wider distribution, and migrated hither, as they are still found living in regions more or less distant, as will be shown farther on; and it is barely possible that a living colony, a remnant of *Tryonia* may yet be discovered somewhere within the desert area.

It has been implied herein that the metropolis of the form called *Tryonia* was here in the former lake or lagoon region of the Colorado desert or basin, for the reason of the great multitude of individuals; its specific center may have been far to the north, nearer to the point from which the Wheeler specimens, referred to by Mr. Tryon, were obtained; it has not been found and is not known to be living elsewhere, at the present time. As to the other molluscan forms which once lived here and are now found dead either at or below the surface, an inquiry as to the localities where they are still found living,[1] and the probable paths of distribution which brought them together as congeners or



Amnicola longinqua Gould (showing range of variation). Drawn by Stearns from recent specimens collected by Henry Hemphill, in Utah Territory.

neighbors of *Tryonia*, incidentally furnishes further information pertaining to the specific region formerly occupied by these species.

[1] *Amnicola longinqua*, has recently been collected *living* in Utah by Mr. Hemphill.

An examination of Lieut. Wheeler's Drainage Map[1] of the territory west of the one hundredth meridian, shows the position of the Colorado as related to the other basins, to be diagonal, its general trend being north-easterly and south-westerly.

"The region of country drained by the Colorado and its tributaries is about 800 miles in length and varies from 300 to 500 miles in width, containing about 300,000 square miles, an area larger than all the New England and Middle States, with Maryland and Virginia added, or as large as Minnesota, Wisconsin, Iowa, Illinois and Missouri."[2]

While it may be presumed that these forms so intimately related have gradually through a great period of time spread from the higher altitudes to the lower, from the older formations to the more recent, extending the area of their distribution as fast as the emergence of the land above the sea and the emerged surface had undergone those modifications necessary to fit it for their occupancy, and are still spreading to new localities; so perhaps in other portions of the area of their domain they are decreasing or dying out, or have already died out, through modifications in the environment as in the now dried up lake or lagoons of the Colorado desert.

It is highly probable that at numerous places within the great interior basin, after the emergence of the land, fresh water lakes, ponds and streams occurred and existed for a time, and became peopled, in part by fluviatile species, such as we are now considering, including varieties of the mussels, intermediate and connecting links between the desert specimens and those from the Wahsatch stations referred to.

It is to be expected that in course of time when this great interior wilderness is thoroughly explored, that living specimens will also be found in those streams and lakes whose waters are still sweet; and with a sufficient number of specimens living and fossil from these two classes of stations, we may be able to trace the lines of distribution, which followed not alone the direct course of streams, for instance like the Colorado, but descended also to the great basin from the now lofty altitudes of the Sierra Nevada, and the parallel ranges on its eastern flank on one side, as from the corresponding regions in the Wahsatch range and sub-

[1]In Lieut. Wheeler's Annual Report, 1876.

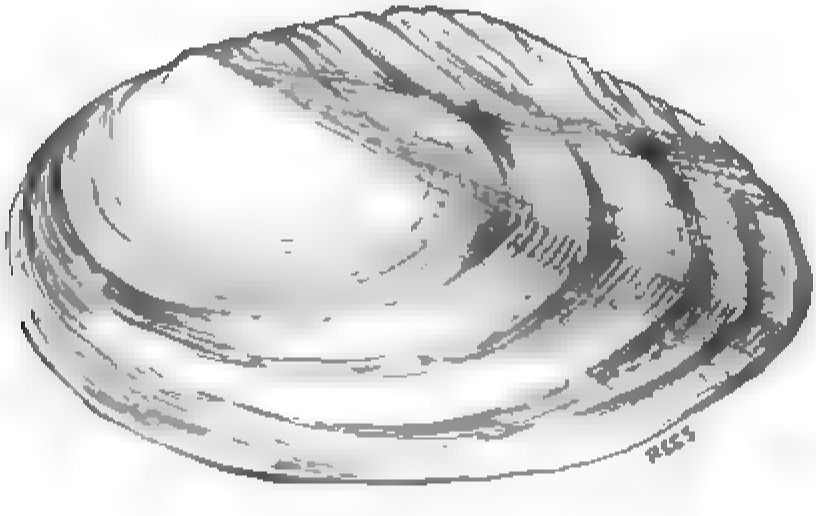
[2]Exploration of the Colorado of the West, etc., by Prof. J. W. Powell, 1875, p. 3.

sidiary ranges upon its western flank on the other, spreading laterally as well as in the direction of what may be regarded as the great highways furnished by the main stream and its principal confluents.

That we may have a better idea of the Colorado river and its tributaries, and of the regions traversed by the latter, I will quote the eloquent description of Prof. Powell.

"There are two distinct portions of the basin of the Colorado. The lower third is but a little above the level of the sea, though here and there ranges of mountains rise to an altitude of from two to six thousand feet. This part of the valley is bounded on the north by a line of cliffs, which present a bold often vertical step, hundreds or thousands of feet to the table lands above.

The upper portion of the basin rises from four to eight thousand feet above the level of the sea. This high region on the east, north and west, is set with ranges of snow-clad mountains attaining an elevation above the sea varying from eight to fourteen thousand feet. All winter long on its mountain crested rim, snow falls, filling the gorges, half burying the forests, and covering the crags and peaks with a mantle woven by the winds from the waves of the sea—a mantle of snow. When the summer sun comes, this snow melts, and tumbles down the mountain sides in millions of cascades. Ten million cascade brooks unite to form ten thousand torrent creeks; ten thousand torrent creeks unite to form a hundred rivers beset with cataracts; a hundred roaring rivers unite to form the Colorado, which rolls, a mad, turbid stream, into the Gulf of California."



Anodonta. Owen's River, Cal.

While the specimens from Washoe lake are in every feature so close to those from Bear river in the distant Wahsatch range, the mussels inhabiting Owen's river at an elevation of 4000 feet on

the easterly flank of the Sierra Nevada, exhibit a considerable variation when compared with those from the preceding places.[1]

The Owen's river specimens, though inhabiting so elevated a station, closely resemble those found at, and in the neighborhood of Los Angeles at an elevation of only 280 feet, and the specimens from both of these places as well as specimens from other stations with similar elevations within the southern portion of the limits of the coast drainage area of California as shown in Lieut. Wheeler's map, and which stations more closely approximate to the level of the desert region, are exceedingly close in their general aspect and minuter characters to the dead shells of the extinct lagoons, and to Lea's type[2] from the Colorado, presumably in the neighborhood of Fort Yuma. At many points within the drainage area described in the foregoing reports the *Anodontæ* have been detected.

I am under obligations to Dr. Edward Palmer for specimens from Utah lake, and to Mr. Henry Hemphill for specimens from Bear river, also in Utah Territory. These localities are in the Wahsatch range, at an elevation of over 4,500 feet above the level of the sea.

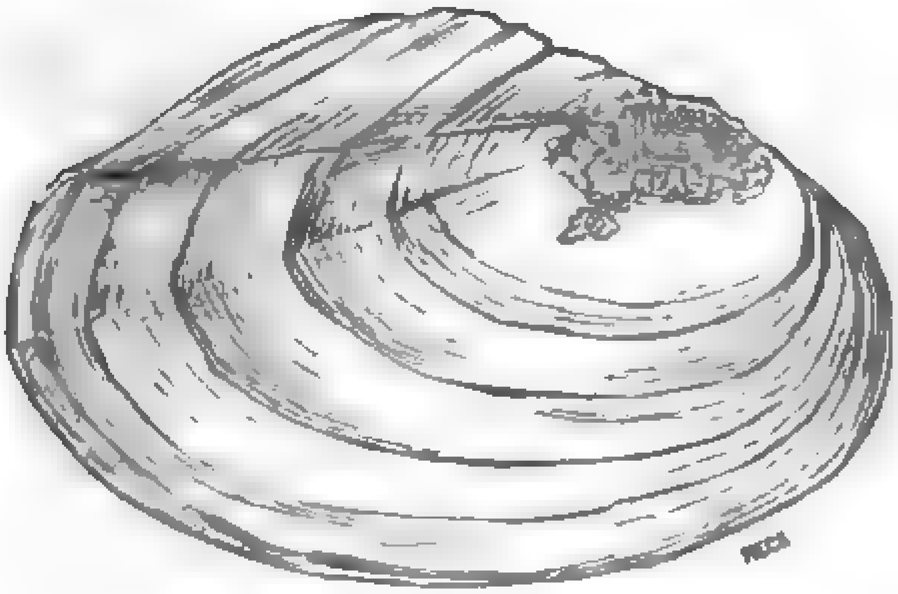
The differences between the specimens from these two locali-

[1] The Owen's lake has no outlet and is fed by the Owen's river, a stream about thirty feet wide, two feet deep and having a velocity of about five miles per hour. As the level of the lake remains constant, there must be perfect equilibrium between the amount of evaporation and the incoming water. The lake having one hundred and ten square miles of surface, and evaporation of 4.6 feet per year, would suffice to swallow up the annual volume of Owen's river.

Those who cannot appreciate the amount of evaporation, have invented the hypothesis of a subterranean outlet, as in the case of the Great Salt Lake in Utah.—*Wheeler's Annual Report, 1876, p. 189.*

[2] Explanatory of my allusions to variation, herein, as shown by a comparison of the Anodons from one place with those from another, to prevent misapprehension I should state, that I do not regard variation as exhibited in the West American forms under discussion, as of specific value, a conclusion I have arrived at after a long and careful study of the relation of variation to environment. While forms or colonies of a form belonging unquestionably to the same species, and inhabiting stations only a short distance apart, often exhibit aspects of variation in such a degree as to appear phenomenal, the cause thereof not being immediately obvious, a careful investigation of the environment frequently rewards us, if not with a full explanation, with a clue or a ray of light.

ties are these: The river shells present a somewhat more ovate outline, are rather more elongated transversely, and are darker colored than the lake specimens. These Bear river mussels are so exactly like those collected by Mr. C. D. Voy in Washoe lake,



Anodonta. Bear River, Utah Territory.

which has an elevation of 4,000 feet in the Sierra Nevada, that though the two regions are separated by between seven and eight degrees of longitude, if numbers of individuals of the same sizes from these two localities were mixed without previous marking, they could not be segregated, with any degree of certainty, so closely are they alike in form, color, incremental lines and zones, which warrants the assumption that the factors of the environment are the same at both stations.

The fragments of *Anodontæ*, met with in the desert, are portions of shells (valves) having the same outline as that figured and described by Dr. Lea, in 1852,[1] from specimens collected by Dr. J. L. LeConte of Philadelphia, in the "Rio Colorado, California," and which Lea remarks as closely allied to "*An. nuttalliana*" from the "Wahlamet river, Oregon," previously described by that author.[2]

[1] Trans. Am. Phil. Society, 2d Series, Vol. x.

[2] Eight species of fresh water mussels have been described from Western North America, west of the Rocky mountains and north of Mexico; of these six belong to the group *Anodonta*; of these six *Anodons*, four, namely *A. nuttalliana*, *A. wahlamatensis*, *A. oregonensis* and *A. californiensis*, are regarded by me as varieties of one and the same species.

In a paper "On the variation of the fresh water mussels," etc., of this western region of America, now nearly ready for the press, I point out the features of their variation and indicate the influences which have induced it. Seven of the eight species alluded to, were described by Dr. Lea.

The remarkable season of 1861-2, when the great California basin was flooded and the larger portion of the valleys included between the coast range and the Sierra Nevada was for weeks covered with water, and connected at times, so as to form an extensive lake, this winter also embraced within the area of its severity the more interior basin east of the Sierra. While, doubtless, the volume of the Colorado was greatly increased through the contributions of its tributaries in its upper portion, it also must have received an extraordinary supply from the drainage slopes farther to the south. The record of unusually high water or floods in the Colorado includes the winter of 1861-2 as well as several seasons not remarkably wet in California. In the preliminary report of Lieut. Bergland,[1] on the feasibility of diverting the Colorado for the purposes of irrigation, he estimates the area of depression below the sea level within the limits of California at approximately "1,600 square miles," yet during the severe winter especially referred to, an area estimated to be sixty miles long by thirty miles wide was covered with water.[2] A portion of this was without question the surplus surface drainage from the adjacent country as well as the overflow of the Colorado, though the New River channel, and the main stream may have poured a portion of its water, in times gone by, over the desert, through other channels.

The sedimentary deposit under consideration and the lake whose waters once held it in suspension, and covered the present desert, may be accounted for in this way, and its permanence, over the area covered and the depth of water on which its area depended, only required a more constant volume in the Colorado, a less rapid rate of evaporation, even if the topographical features are the same now as then.

With the data accumulated by various intelligent and trustworthy observers, and accessible to all who are disposed to investigate, we are justified in the conclusion that without spasmodic

[1] Wheeler's Report, 1876, p. 109.

[2] Mr. Jaeger, owner of the Ferry at Fort Yuma, and a resident of the place since its establishment as a military post, says, "Heavy floods in 1840, 1852, 1859, 1862 and 1867. Tasted the water flowing in channel at New River station in 1862, and found it fresh water. A Mr. Jones (now dead) told me that he came along the west side of the great basin in 1862, on his way from San Bernardino to New River, and saw in the basin a great lake, some sixty miles long by thirty wide. This came from the overflow in 1862." Id. 118.

or catastrophic action, the present condition of the desert is the result of gradual and slowly working causes, and that within comparatively recent times, there has been a decreasing mean average rain and snowfall to the north, in the higher regions which are drained in this direction, and also an increasing but gradual elevation combined with increased evaporation.

While *Tryonia* as before stated is apparently local, the other species are widely distributed. The *Anodontæ* (mussels) not only inhabited the area from the Wahsatch mountains on the east, to the Pacific ocean on the west, but from the Colorado on the south to and north of the Columbia river in the north, their migration in the latter direction having been from the Wahsatch region also, as appears probable when we consider the statement of Dr. James Blake,[1] "that the divide between the waters of the Great Basin and of the Columbia is the ridge * * * in latitude 41° 33′ N., longitude 113° 29′ E., * * * 600 feet (in height) above the level of the Salt Lake basin." And further he remarks "the height of the divide above the level of Queen's River valley is about six hundred feet, but I am of the opinion that other outlets must exist, which allowed the waters of the basin to attain a still lower level, before their disappearance solely by evaporation began. There must have been a large body of water left to disappear by evaporation, as the concretionary deposits * * * are found at an elevation of two hundred feet above the level of the valley and they could only have been deposited as the water became concentrated by evaporation. * * * Large numbers of *Anodonta* shells are found on the surface of the ground, entirely encased in this concretionary substance, to the thickness of two or three inches."

Of the two forms of *Planorbis* (*P. gracilentus* Gould, found dead in the desert, and *P. ammon* Gould, found living in the Colorado river) one is closely similar to other widely distributed

[1] Proc. Cal. Acad. Sci. Vol. iv. (p. 277, Oct.) 1872.

Dr. Hayden believes that his parties have fixed the position of the ancient outlet of the great lake that once filled the Salt Lake basin. This appears to have formerly drained into the Columbia river; and the lowest pass between the great basin and the drainage of the river is continued directly south at the head of Marsh creek, and so low is it that one marsh connects two streams, one flowing to the Bear river and the Great Lake, and the other to the Portneuf and Snake rivers of the Columbia. This generalization was actually made several years ago, but only fully established during the past season.—*Harper's Weekly, March 2d, 1878.*

forms, to which authors have given many specific names, but which I regard as varieties only of one and the same species. The *Physa* (*P. humerosa*), also though a well marked form in certain respects, I am inclined to place as simply a southern or warm climate variety of the widespread *P. heterostropha* Say, which inhabits an area extending from the Atlantic seaboard, to the Great Slave lake in the north, to the Pacific coast on the west, and is found also in Utah Lake.

And here I would remark that I do not assert that the distribution of these several molluscan forms may not have been through other channels and by other lines; from the Sierra perhaps, down its eastern flank or from some point or points in the coast range further to the east.

There are other agencies and methods of distribution, which I will refer to briefly, before closing. The *Anodontæ*, for instance, when young, sometimes attach themselves, by their valves, to the fins of fishes, and are carried to new localities in this way, as well as by being swept along by streams. Physa and Planorbis in their embryonic stage are contained in a soft and sticky mass of jelly; this gelatinous mass adheres to the legs and feathers of birds, especially aquatic species, and is carried often to great distances from the original habitat; again tornadoes and water spouts act as distributing agents, taking up the waters of lakes and streams, and the chips and twigs which frequently abound therein, and transporting the same to places many miles away, where they are deposited, sometimes, in other streams or ponds. It is quite common to find the sticky egg-mass as well as adult individuals of the fresh water snails, adhering to such objects.

And now after a somewhat prolonged and perhaps tiresome journey over a rather wide region, pursuing such suggestions as have been evolved from time to time during the progress of our inquiry, let us return to the place of beginning, where I will conclude by repeating the noteworthy facts, perhaps without parallel elsewhere, namely the level of the Southern Pacific Railroad in the Colorado desert, as compared with that of the ocean. Here we have several miles of railway upon a plane nearly 200 feet below the sea level, and locomotives supplied with fresh water from a well 240 feet below the level of the ocean; the latter, if not the deepest, being certainly one of the remarkable wells of the world.

THE DISTRIBUTION OF THE NORTH AMERICAN FLORA.

BY SIR JOSEPH DALTON HOOKER.[1]

WHATEVER countries beyond the seas we may visit, in the temperate regions of the globe, we find that their vegetation has been invaded, and in many cases profoundly modified by immigrant plants from other countries, and these are in almost all cases natives of North-western Europe. Nearly forty years ago I arrived at night at the Falkland islands, when a boat was sent ashore to communicate the ship's arrival to the Governor; and, being eager to know something of the vegetation of the islands, I asked the officer in charge of the boat to pluck for me any plants he could feel for, as it was too dark to see anything, and the armful he brought to me consisted of nothing but the English shepherd's purse. On another occasion, landing on a small uninhabited island,[2] nearly at the Antipodes, the first evidence I met with of its having been previously visited by man, was the English chickweed; and this I traced to a mound that marked the grave of a British sailor, and that was covered with the plant, doubtless the offspring of seed that had adhered to the spade or mattock with which the grave had been dug.

It was hence no surprise to me to find myself, on landing at Boston last summer, greeted by Western European plants that had established themselves as colonists in New England. Of these the first was the wild chicory, growing far more luxuriantly than I ever saw it do elsewhere, forming a tangled mass of stems and branches, studded with turquoise-blue blossoms, and covering acres of ground; the very next plants that attracted my attention were the oxeye-daisy and Mayweed, which together whitened the banks in some places, and which I subsequently tracked more than half way across the continent.

These, and more than two hundred and fifty other Old England plants, which are now peopling New England, were for the most part fellow-emigrants and fellow-colonists with the Anglo-Saxon, having (as seeds) accompanied him across the Atlantic, and having, like him, asserted their supremacy over and displaced a certain number of natives of the soil.

[1] A lecture by Sir Joseph Dalton Hooker, K.C.S.I., Pres. R. S., delivered on April 12, 1878, before the members of the Royal Institution of Great Britain. [Reprinted from the *Gardeners' Chronicle*, August, 1878.]

[2] Lord Aukland's island, south of New Zealand.

Turning to the hotter parts of North America, the same process of invasion by natives of the Old World is going on: a British-Indian plant[1] has established itself in the streets of Savannah, and so entirely simulated the habit of a native weed, that American botanists gave it a new name, regarding it as indigenous; and one of the most curious cases of plant invasion known to me is that of the mango tree in Jamaica, which reminds one of the accounts of captured tribes, which, after being carried into their conqueror's country, have so increased and multiplied, as eventually to dispossess and supplant their captors. In 1782, Admiral Rodney took a French ship, bound for St. Domingo from Bourbon, with living plants of the cinnamon, jack-fruit and mango, sent to the botanical gardens of the former island by that of the latter. These undistinguished prizes the Admiral presented to the Jamaica Botanical Gardens.

There the cinnamon was carefully fostered, but proved to be (as it is to this day) difficult of culture in the island; whilst the mango, which was neglected, became in eleven years as common as the orange, spreading over lowlands and mountains from the sea-level to five thousand feet above it. On the abolition of slavery immense tracts of land, especially coffee estates, relapsed to a state of nature, and the mango being a favorite fruit with the blacks, its stones were flung about everywhere, giving rise to groves along the roadsides and settlements; and the fruit of these again, rolling down hill, gave rise to forests in the valleys and on their slopes. The effect of this spread of the mango has been to cover hundreds of thousands of acres, and to ameliorate the climate of what were dry and barren districts, by producing moisture and shade, and by retaining the rainfalls that had previously evaporated, besides affording food for several months of the year to both negroes and horses. It may well be, that by future generations in Jamaica, Admiral Rodney will be known less for his victory over Count Grasse, and being the first to "break the enemy's line" than as the capturer of the mango tree in the Spanish Main.

And it is the same in all countries colonized by the Anglo-Saxon; so firmly have the plants he has brought with him established their foot, or rather, roothold in the soil, that were he and all other evidence of his occupation to disappear from North

[1] *Fragaria indica* Andr. (*Potentilla durandii* Torr. and Gr.).

America, these, his fellow-emigrants, would remain as witnesses of his former presence, not only on the shores and in the forests of the older States, but in the interior prairie and the newly settled valleys of the Rocky mountains themselves.

Time does not permit me to dwell longer upon this subject of immigration during the historic period. I must now hasten to consider the flora of North America as it was for an indefinite period before the arrival of the Anglo-Saxon, embracing prehistoric and geological epochs; we have to regard this flora as a whole, and as subdivisible into local floras, characterized by the prevalence of certain assemblages of plants; to connect these local floras with the geographical features of the areas they occupy; to account for their position and composition by a reference to the countries from which their components may have been derived, and to the means of communication which exist, or may in former times have existed with these countries.

Before proceeding with this inquiry I will indicate, with the aid of the map, those prominent features of North American geography, which have regulated the distribution of its plants.

Physical Conformation of America.—In the Arctic regions the three northern continents approach, and the hydrography and geography of these regions favor the assumption that in former times they may have been connected. Next we observe that in the American continent (unlike the European and Asiatic), the great obstacles to the intermingling of floras, the mountain chains, are longitudinal; as are the principal valleys, which are the great aids to their diffusion. If we now run a section across the continent along its principal parallel (that near 40°), which approximately coincides with the isotherm of 55°, we find that it (see p. 5), represents tolerably well any other parallel to it in those meridians in which there is the greatest development of a temperate vegetation. Commencing on the east, there is first the Atlantic seaboard, bounded to the westward by mountain ranges of moderate elevation (rarely attaining 6000 feet), which under various names extend from New Brunswick, in lat. 48°, to Alabama and Georgia, in lat. 34° (and which have been collectively called the Appalachian chain). Westward of this chain are the broad, low well-watered valleys of the Ohio, Mississippi and Missouri, the latter in its intersection with our principal parallel being nearly midway across the continent and 1300 miles from the Atlantic.

From the Missouri the ascent is very gradual to the elevated region of the Rocky mountains, which consist of a complicated series of rocky ridges rarely exceeding 14,000 feet elevation, occupying a belt 300 miles broad from east to west. These ridges inclose very large, well-watered, open grassy valleys, called Parks, the rivers from which usually discharge from the range through narrow gorges, called cañons.

The parks and valleys to the east of the mountainous belt present the gray-green (grassy) vegetation of the prairie, those on the west, the hoary sage-bush (Artemisia) vegetation of the dry country to the westward; and these often intersect, so that a transverse ridge may separate a green and well-watered park from a hoary and dry one.

The descent from the Rocky mountains on the west is on to a tract elevated upwards of 4000 feet above the sea, extending for 400 miles to the foot of the Sierra Nevada. This tract is intersected by several short ranges 8000 feet high and upwards; its climate is dry, its soil saline, and many of its rivers lose themselves in salt lakes and marshes, whence the local names of Great basin, and of the Sink, Salt-lake and Desert regions. The Sierra Nevada succeeds, rising steeply to an elevation of 12,000 and sometimes of 15,000 feet. Under various names it traverses America, with little interruption, from Alaska to Southern California, at a distance of one hundred to one hundred and fifty miles from the Pacific; but its breadth is nowhere so great as that of the Rocky mountains. The descent from it to the westward is into the great valley of California, whose floor is raised but little above the sea-level, and between which and the Pacific are the low and narrow coast ranges, of which the southernmost in Southern California unites with the Sierra Nevada.

Turning now to the flora of North America north of the tropic, we find that the distribution of its plants is in remarkable conformity with its geographical and climatal features, being in meridional belts from the Arctic ocean to the gulf of Mexico; the botanical components of these belts differing more and more in advancing south, till in the principal parallel that we have traced, the diversity between the eastern and western belts is greater than between any two similarly situated regions on the globe.

Polar Area.—Commencing in the Polar area, the Arctic American flora, though on the whole a uniform one, is distinctly divisi-

ble into three; the first extends from Behring's straits to the mouth of the McKenzie river, and is marked by the presence of certain Asiatic genera and species that advance no farther eastward; the second extends thence onwards to Baffin's bay, and presents various American genera and species not found either eastward or westward of it; and the third is that of Greenland, which is almost exclusively European, and presents several anomalies which I shall hereafter discuss. Besides this eastern and western distribution of the Arctic flora, it streams southward along the three meridional mountain chains of the continent.

British North American Flora.—South of the Arctic flora is that of the British possessions, that is, of temperate America north of the 47th parallel; it consists of a mixture of North European, North Asiatic and American genera, in very different proportions, disposed in five meridional belts. 1, to the eastward, the Canadian forest region; 2, the woodless region, a continuation of the prairie region farther south; 3, the Rocky mountain region, where Mexican genera appear; 4, a dry region, a continuation of the Desert or Sink regions to the south of it; and 5, the Pacific region, which assimilates very closely in its vegetation to that of Kamtschatka.

United States Flora.—It is on entering the United States that the flora of temperate North America attains its great development of genera and species in all the meridians, and that the boundaries of the meridional belts of vegetation are most strictly defined.

I. The great eastern forest region, extending over half the continent, and consisting of mixed deciduous and evergreen trees, reaches from the Atlantic to beyond the Mississippi, dwindling away as it ascends the western feeders of that river on the prairie. It is noteworthy for the number of kinds especially of deciduous trees and shrubs that are to be found in it, even on a very limited area. Of this I shall select two examples from my journal. One was a patch of native forest a few miles from St. Louis, on the Missouri, where in a little more than half an hour, and less than a mile's walk, I saw forty kinds of timber trees,[1] including eleven of oak, two of maple, two of elm, three of ash, two of walnut, six of hickory, three of willow and one each of

[1] For the indication and names of them I am indebted to Dr. Engelmann, of St. Louis, who took me to the forest.

plane, lime, hornbeam, hop-hornbeam, laurus, drospyros, poplar, birch, mulberry and horse-chestnut; together with about half that number of shrubs.

The other example was afforded me by Goat island, which divides the great cataract of Niagara, and covers less ground than Kew Gardens. Here the vegetation was more boreal and less varied than in Missouri; but with Dr. Gray's aid I counted thirty kinds of trees, of which three were oaks and three poplars, together with nearly twenty different shrubs.

I know of no temperate region of the globe in which any approach to this aggregation of different trees and shrubs could be seen in such limited areas, and perhaps no tropical one could afford a parallel.

No less remarkable is the composition of the flora of the Eastern States. Prof. Gray has shown that most of its genera are common to Europe and Asia, but that very many are all but confined to North-eastern Asia and Western America. This generic identity, however, gives but a faint idea of the close relationship between the East American and East Asiatic, especially the Japanese, floras, for there is further specific identity in about two hundred and thirty cases, and very close representation in upwards of three hundred and fifty; and what is most curious is, that there are not a few very singular genera, of which only two species are known, one in East Asia, the other in East America; and in some of these instances the Asiatic species is a wide-spread plant in East Asia, whilst the American is an extremely scarce and local plant in its country, which with other considerations render it conceivable that the Asiatic element in East America is a dying-out one.

Leaving out of consideration the purely American genera of this flora, there remain the genera common to Europe, Asia and America; the genera confined to America and Asia; and the genera confined to America and Europe. I shall give an illustration of the proportions in which these occur by a reference to the principal trees and large shrubs only, their names being familiar to you, though the smaller shrubs and herbs afford infinitely more numerous and striking examples; thus, of those common to the three northern continents, I find in America thirty-eight genera with about one hundred and fifty species; these include maples, ashes, hollies, elms, planes, oaks, chestnuts, nut,

hornbeam, birches, alders, willows, beech, poplars, &c. Of those confined to America and East Asia I find in America thirty-three genera and fifty-five species, including magnolias, tulip tree, negundo, wistaria, Virginia creeper, gleditschia, hydrangea, liquidamber, nyassa, tecoma, catalpa, diospyros, sassafras, benzoin, mulberry, walnut and others which, not being European, are unfamiliar to you. Lastly, of those confined to Europe and America I find only one genus, namely, the hop-hornbeam, of which there is but a single representative in each country.

Here, then, is conclusive evidence of the close botanical relationship of North-eastern Asia and Eastern North America; a relationship of which there is but little evidence in the vegetation of the prairies and Rocky mountains, and still less, perhaps, in the regions farther west.

II. The prairie region succeeds a grassy land with many peculiar herbaceous American genera, including Mexican types, of which last the most conspicuous are a yucca and cacti, which latter increase in number as the Rocky mountains are approached, where they form a noticeable feature in the landscape.

In the parks and lower valleys of the Rocky mountains, deciduous trees are few and scattered, and the forest is an open one of conifers, amongst which a pine, allied to the American nut-pines, *P. edulis*, first appears. Higher on the mountains the coniferous forests are dense, and almost the only deciduous tree is an aspen, which forms impenetrable brakes on the slopes and in the gullies. Above the forest region are the sub-alpine and alpine regions, presenting a mixture of European, Asiatic and American types.

III. Descending to the Sink region the cacti and yucca almost disappear, though they increase to a maximum farther south in this meridian. Deciduous trees are very few, and confined to the gullies of the mountains, and Mexican genera increase in numbers. The hoary sage-bush (Artemisia) covers immense tracts of dry soil, and saline plants occupy the more humid districts.

Another nut-pine of Mexican affinity (*P. monophylla*) traverses the center of this region in a narrow meridional strip, and the proportion of endemic plants, herbaceous especially, is very large.

IV. The Sierra Nevada is clothed with the most gigantic coniferous forest to be found on the globe, amongst which a very few species of deciduous trees are scattered; but none of these are

identical with trees of the eastern forests, though several are representative of them. New Mexican genera occur at all elevations from the crest of the range to its base, and thence extend across the Californian valley and the coast-ranges to the Pacific, mixed with northern West American genera and species.

In this slight outline of the botanical features of temperate and Arctic North America, I have alluded to three as most noteworthy, namely: the vegetation of Greenland, the Asiatic character of the vegetation of the eastern half of the continent, and the more southern and even Mexican character of the vegetation of the western half. How are these features to be accounted for?

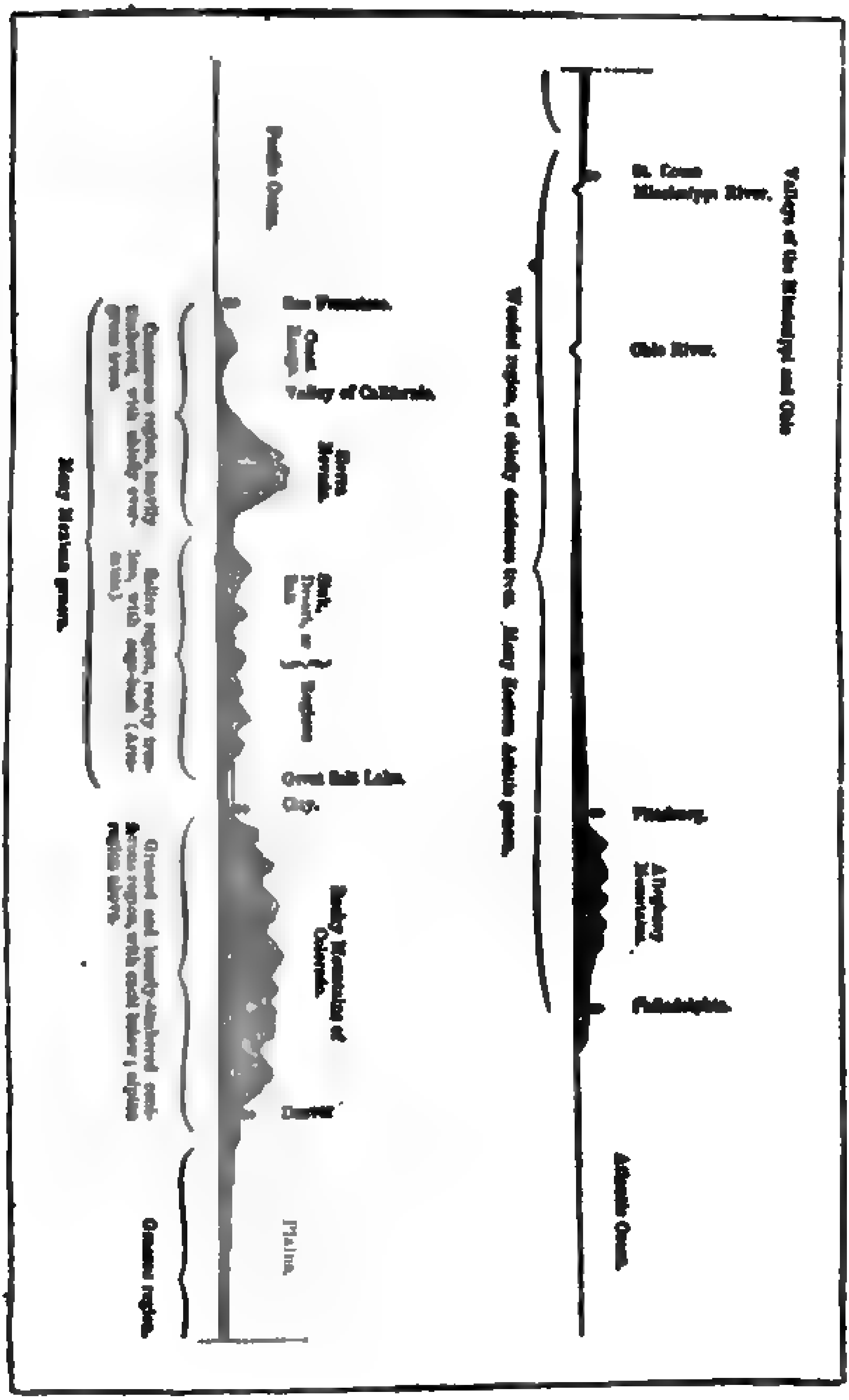
It so happened that Dr. Gray, Prof. of Botany in Harvard College (Cambridge), and I were contemporaneously, but without concert, engaged in botanical investigations which have resulted in explanations of the two first features. He was at work on the flora of Japan,[1] I on that of the Polar zone,[2] and we were both bringing to bear upon our subjects considerations regarding the variation of species which Mr. Darwin[3] almost simultaneously laid before the public, and which, I need not say, powerfully directed our studies.

The Greenland Flora.—I shall take the vegetation of Greenland first, as being first in order, though second in date of appearance and least in importance. Its chief peculiarities are: 1, that its plants are almost all of them Scandinavian (that is, North-west European), hardly any of the peculiar plants of the American arctic sea-coast and polar islands crossing Baffin's bay and Davis straits; 2, that of its three hundred flowering plants hardly any present even a variation from their Scandinavian prototypes; 3, that it is poorer in species than is any other division of the arctic flora, and wants many Scandinavian plants that are found in most other arctic countries; 4, that though Greenland extends four hundred miles south of the Arctic circle, its extra-arctic continuation adds only about one hundred species to the flora, and these

[1] "Observations upon the Relations of the Japanese Flora to that of North America, and of other parts of the North Temperate Zone." Memoirs of the American Academy of Sciences, Vol. VI, p. 377. Read December 14, 1858, and January 11, 1859.

[2] "Outlines of the Distribution of Arctic Plants." Read before the Linnæan Society of London, June 21, 1860. Trans. Linn. Soc., XXIII, p. 257.

[3] "On the Tendency of Species to form Varieties," by C. Darwin, Esq., F.R.S., and Alf. Wallace, Esq. Read July 1, 1858. Journal of the Proceedings of the Linnæan Society of London, Vol. III (Zoölogy), p. 45.



Section of North American Continent in about Lat. 40°.

all cross the Arctic circle in other longitudes; 5, some Greenland species are confined to it and to the mountains on the Atlantic

side of America, being found nowhere else in Arctic or Sub-arctic America.

My explanation of these anomalies was, that at a period previous to the glacial, a flora common to Scandinavia and Greenland was spread over the American polar area, and that on the accession of the cold of that period this flora was driven southwards, and was affected differently in different longitudes. In Greenland many species were exterminated, being as it were driven into the sea at the southern extremity of the peninsula, where only the hardiest survived. On the return of warmth the Greenland survivors migrated northward, peopling the peninsula with the hardiest of the species of its former flora, unmixed with American species; and unchanged in aspect from never having been brought into competition with those of any other flora. On the other hand, the same Scandinavian plants when driven south on the plains of the continent multiplied there in individuals, and being brought into competition with American species descending from the continental mountains on to the plains, assumed varietal forms. On the return of warmth, therefore, many Scandinavian species that had been exterminated in Greenland would, having survived on the continent, travel northwards on it, some unchanged, others under varietal forms, accompanied with the American species that had descended from the mountains during the cooling of the continent. Lastly, as some of the Scandinavian species were no doubt local, and confined to near the meridian of Greenland, it is not surprising to find that a few such should survive only in Greenland and on the eastern alps of North America.

Thus only could I satisfactorily account for the almost complete identity of the Greenland flora with the Scandinavian after such changed conditions of climate; for the paucity of its species; for the absence in it of varieties; for the rarity in it of peculiarly American species; for the few species which extra-arctic Greenland adds to its arctic flora; and for certain of its plants being limited in range to Greenland and the eastern American alps.

North Asiatic and North American Floras.—The relationship between the flora of North-east Asia and Eastern North America has been fully explained by Dr. Asa Gray in an essay on the flora of Japan, which is the first entirely satisfactory contribution of its kind to the science of botanical geography known to me.

After a detailed comparison of the botany of Japan and North America, and proving their affinity, Prof. Gray refers to the fact that many of the existing genera and even species of both floras coëxisted in the high latitudes of America during Miocene times, as shown by Heer and other palæontologists; during which period he further assumes that the three northern continents were conjoined, or so nearly contiguous as to allow of a commingling of their floras.

The glacial period followed, carrying an arctic climate south to the latitude of the Ohio, but so gradually, that these plants were not exterminated, but wholly or in part driven southward, followed in the rear by the arctic vegetation. As the temperature rose with the retreating ice, this flora returned northward, leaving the arctic and sub-arctic plants on the mountains of both East and West America.

He next shows that the retreat northward was to a somewhat higher latitude than the same plants now attain; and this he accounts for by a reference to the fluvial epoch of Dana,[1] when the region of the great lakes was submerged five hundred feet below their present level. This diminished area and lowered elevation of the land, by inducing a milder climate than now obtains in the lake region, favored the extension of the flora to a higher latitude than it now attains, and hence effected a second commingling of American and Asiatic plants. Lastly, Dana's Terrace epoch supervened, when the previously depressed northern region was again raised, cooling the climate, finally dissociating the Asiatic and American floras, and giving to the arctic and sub-arctic plants of the continent their present limits.

It remains now to account for the great rarity of East Asiatic types in America west of the prairies, and the presence in those meridians of Mexican and still more southern ones. Hitherto there have been no other attempts at a solution of this problem than such unsupported speculations as that the western half of the continent, though so much the loftier, was submerged during the southern migration of the northern miocene plants; or that the climate of the West was unsuited to the habits of these, which

[1] Whilst these pages were still in the press, Prof. Gray has informed me that he now lays little stress on the conditions supposed to be due to the terrace and fluvial epochs; and that he is rather disposed to consider the separation of the northern floras by the Glacial epoch to have been final.

appears to me to be at variance with the fact that when imported into it they thrive luxuriantly.

The explanation which I have to offer will be best understood by a reference to the section (p. 163), which shows the western half of the continent to be enormously elevated as compared with the eastern, and to have been singularly adapted for the retention of vast bodies of ice for long after the Glacial period. We find there a valley (the desert region), upwards of four hundred miles broad, and upwards of four thousand feet elevation, with many ranges of over eight thousand feet in it, bounded by broad and lofty mountains, together occupying at least two-thirds of the breadth of the western half of the continent. We further know that these mountains were clothed with ice during the Glacial epoch, and that the valley was then occupied by a vast lake; for on the uppermost of the many shelves which the retiring waters of this lake cut on the flanks of the Rocky mountains and Sierra Nevada, the skull of the musk-ox, the most arctic of land quadrupeds, has been found.

It is obvious that this whole western region must have retained its glacial mantle for an incalculable period after Eastern America had been sufficiently warmed to admit of the northward return of the plants that had been driven southward in it; and that this glaciated condition must have effectually barred a similar return of the same plants in those western meridians, these must have perished, in short, on reaching Southern California. Long ages after, when the western ice disappeared, and the climate of the valleys warmed, the Mexican and more southern plants would, as a matter of course, take possession of the unoccupied soil, and advance northward till they encountered the boreal vegetation of North-western America, with which they now commingle.

I have said that the extinction of East Asiatic types in Western America was not total; a few escapes are found in the valleys of the Rocky mountains and Sierra Nevada,[1] and also along the coast of the Pacific, the warming influence of which favored their preservation during the northern migration.

The Sequoias.—Two instances of these escapes are of such interest that I shall, in concluding this lecture, bring them under your

[1] And also on the highlands of Central Mexico, where some Asiatic types remain which have not migrated farther north or south in America. Such are the eminently Asiatic genera Bocconia, Meliosma, Photinia, Cotoneaster, Deutzia and Abelia.

notice; they are those giants of the vegetable kingdom, the Sequoias, the red-wood (*S. sempervirens*), and the "big-tree" or "Wellingtonia" (*S. gigantea*).

The fossil remains of these trees, or species most closely allied to them, are found in Miocene beds in high latitudes all round the globe; in Vancouver's island, Sitka, on the arctic American sea-coast, in Greenland, Spitzbergen and in arctic Asia, &c. The genus, therefore, which first appeared in the Cretaceous times, was undoubtedly a member of that mixed Americano-Asiatic flora that was driven southward during the Glacial period. The genus is now confined to Western North America, and to the two above-named species, but it is represented in Eastern America by the very closely allied genus Taxodium, and in Eastern Asia by Glyptostrobus.

The distribution of the two Sequoias is most instructive. The red-wood forms a dense narrow forest tract for about five hundred miles, skirting the ocean, along whose warmer shore it crept northward after the Glacial epoch. It rivals in height its sister of the Sierra, and attains an enormous girth and age, though I can find no account of any attempt having been made to estimate its age.

The *S. gigantea*, or "big-tree" (the Wellingtonia of British gardens), again, is a plant of a cooler climate; and hence, having survived the glacial cold, was enabled to establish itself in the Sierra Nevada under certain very restricted conditions. It extends at intervals along the western slope of the Sierra to a little north and south of the parallels of 36° and 38° N., that is, for nearly two hundred miles in a north-west and south-east direction, at elevations of five thousand to eight thousand feet above the sea. Towards the north the trees occur as very small, isolated, remote groves of a few hundreds each, most of them old and interspersed amongst gigantic pines, spruces and firs, which appear as if encroaching upon them; such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the big-trees form a colossal forest, forty miles long and three to ten broad, whose continuity is broken only by the deep sheer-walled cañons that intersect the mountains; here they displace all other trees, and are described as rearing to the sky their massive crowns; whilst seen from a distance the forest presents the appearance of green waves of vegetation, gracefully following the com-

plicated topography of the ridges and river basins which it clothes.

But by far the most remarkable fact hitherto reported regarding the disposition of the groves is, that they occupy only those spots in the Sierra which were first laid bare when its icy mantle became broken up into isolated glaciers. Thus, commencing at the north, the gap of forty miles between the Calaveras and Tuolomne groves was occupied by the great glacier of the Tuolomne and Stanislaus rivers; that between the Merced and Mariposa groves by the glacier of the Merced river, which sculptured the famous Yosemite valley; and so on—each successive group of trees occupying a lofty spur between the sites of ancient glaciers, and the greatest continuous extension of the forest (of forty miles) occurring exactly where, owing to the topographical peculiarities of the region, the ground was most perfectly protected from great fields of ice.

Mr. Muir, a very intelligent and accurate observer, who has studied the groves throughout their length and breadth most diligently,[1] and to whom I am indebted for the above and much other information regarding the southern forest of Big-trees, considers that these have never since the Glacial epoch been more widely distributed or in greater vigor than now, and doubts, indeed, if the forests have reached their prime, founding his opinion on the high state of health of the mass of the trees, the multitude of seedlings and saplings in the southern groves, and the absence of any trace of trees having existed outside the present limits of the groves (as of dead trees, stumps, or the great holes left by fallen trees).

Size of the Big Trees.—So little that is trustworthy has hitherto been published regarding the age, size and durability of the Big-tree trunks when fallen, that I shall offer you some accurate data which I obtained on these points chiefly from Mr. Muir. A tree felled in 1875 had no appearance of age, it was 69 feet in girth inside the bark, and the number of annual rings counted by three persons varied between 2125 and 2139. Another was 107 feet in girth inside the bark at four feet from the ground; its wood was very compact, and showed, throughout a considerable portion of the

[1] "On the Post-Glacial History of *Sequoia gigantea*," by John Muir, of San Francisco, Cal. Proceedings of the Amer. Assoc. for the Advancement of Science, Buffalo meeting, Aug., 1876.

trunk thirty annular rings to the inch. This, if the rings were of uniform diameter in the rest of the trunk, would give the incredible age of 6400 years; but as the interior rings of such trees are much broader than the outer, half that number to the inch is a more conceivable estimate, which would give an age of 3200 years. The only other instance of careful counting of rings which I can find is that of the felled tree in the Calaveras grove, which measured seventy feet girth inside the bark at six feet above the ground, and which at forty feet above the ground had 1255 rings. In this case the rings next the bark were thirty-three to the inch, a number which at five feet inward had diminished one-half. The result of many measurements, chiefly by Prof. Whitney,[1] gives, as the average height of full-grown trees, 275 feet, and a maximum a little over 320; a girth outside the bark, at six feet above the ground, of seventy, with a maximum of 120; whilst the maximum age possibly attained may be 4000 years, though this is very improbable.

The duration of the dead wood in the forest is very great. I rarely observed signs of rot in the fallen trees I examined, whilst in similar forests in North California I saw gigantic trunks of silver firs forming mounds of rotten *débris* without an atom of sound wood, and this in two years after their fall, as I was assured. I had no data for ascertaining the length of time during which any of the prostrate Sequoia trunks which I saw may have lain on the ground, but Mr. Muir has supplied me with a very crucial case. It is that of a prostrate trunk with no signs of decay in any part of it, which had been burnt in two by a forest fire, and in the trench between the severed portions of which a silver fir grew. This fir was felled, and had 380 annual rings; therefore, to estimate the time during which the Sequoia trunk had lain uninjured, we must add to the 380 years, first the time it lay before the forest fire burnt it in two, and then the unknown interval between that time and the arrival of the silver fir seed.

The millenia during which these Sequoia trees must have remained *in statuo quo*, proving the long duration of existing conditions of climate, are but as minutes compared with the time occupied by the migration of this very species, or its ancestors,

[1] Very careful measurements of the trees in the Calaveras and Mariposa groves are given by Prof. Whitney (State Geologist) in the Yosemite Guide-Book, published under the authority of the Geological Survey of California (1874).

north and south in the continent of America. Whatever might otherwise be the extent of the Sequoia's travels, they are now at an end. Man has pronounced the sentence, "Thus far shalt thou go, and no farther!" The doom of these noble groves is sealed. No less than five saw-mills have recently been established in the most luxuriant of them, and one of these mills alone cut in 1875 two millions feet of Big-tree lumber; and a company has lately been formed to cut another grove. In the operations of the California wood-cutters the waste is prodigious. The young, manageable trees are first felled; after which the forest is fired to clear the ground and get others out, and thus the saplings are destroyed. More destructive still are the operations of the sheep-farmers, who fire the herbage to improve the grazing, and whose flocks of tens of thousands of sheep devour every green thing, and more effectually than the locust. The devastation of the California forest is proceeding at a rate which is utterly incredible, except to an eye witness. It is true that a few of the most insignificant groves of the Big-trees at the northern extreme of its range are protected by the State Legislature, and that a law has been enacted forbidding the felling of trees over fifteen feet in diameter, but there is no law to prevent the cutting or burning of the saplings, on which the perpetuation of the grove depends, or to prevent the burning of the old trees, which, if they do escape the fire, will succumb to the drought which the sweeping away of the environing forest will occasion.

During the last quarter of a century the Anglo-Saxon has been ruthlessly carrying fire and the saw into the forests of California, destroying what he could not use, and sparing neither young nor old, and before a century is out the two Sequoias may be known only as herbarium specimens and garden ornaments; indeed, with regard to the Big-tree, the noblest of the noble coniferous race, the present generation, which has actually witnessed its discovery, may live to say of it, that "The place which knew it shall know it no more."

THE ORIGIN OF THE SPECIALIZED TEETH OF THE CARNIVORA.

BY E. D. COPE.

THE specially developed teeth of the Carnivora are the canines and sectorials. The former are large in many orders of *Mammalia*, and their origin is probably to be sought among the Theromorphous reptilia,[1] as *Clepsydrops* and *Deuterosaurus*, if not in still lower types. The successive modifications of form which have resulted in the existing specialized single sectorial tooth of the *Felidæ* have been already pointed out.[2] They were shown to consist in the gradual obliteration of the internal and posterior tubercles and the enlargement of the external anterior tubercle in connection with an additional anterior tubercle. The modification in the character of the dentition taken as a whole, was shown to consist in the reduction in the number of teeth, including the sectorials, until in *Felis*, etc., we have almost the entire function of the molar series confined to a single large sectorial in each jaw.

Observation on the movements of the jaws of Carnivora shows that they produce a shearing motion of the inferior on the superior teeth. This is quite distinct from the sub-horizontal movement of Ruminants, or the vertical motion of hogs and monkeys. Examination of the crowns of the sectorials shows that the inner side of the superior, and the external side of the inferior, are worn in the process of mastication. The attempt to cut the tough and stringy substances found in animal bodies, is best accomplished by the shearing of the outer edge of the lower molar on the inner edge of the external tubercles of the superior molar in an animal with simple tubercular teeth. The width of the mandible is too great to allow the inferior teeth to shear on the inner edge of the inner tubercles of the superior series. The cusps of both superior and inferior teeth engaged in this process, have developed in elevation, at the expense of those not engaged in it, viz: the internal cusps of the same teeth. The atrophy of the latter cannot have been due to friction, since the internal cusps of the inferior series which have not been subjected to it, are reduced like those of the superior sectorial, which have. Indeed, it is possible that some of the *Creodonta*, the carnivores of

[1] American Naturalist 1878 p. 829.

[2] Cope, Proceedings Academy Philada., 1865, p. 22.

the lower Eocene, may have been derived from ancestors without or with rudimental inner cusps. In any case the effect of use in lengthening the cusps appears to have operated in the Carnivora, as it has done to a greater degree in the *Ungulata;* and the lateral vertical wear would appear to have resulted in the blade-form, as transverse wear in the Ungulates has resulted in the plane grinding surface.

The specialization of one tooth to the exclusion of others as a sectorial, appears to be due to the following causes. It is to be observed in the first place that when a carnivore devours a carcass, it cuts off masses with its sectorials, using them as shears. In so doing it brings the part to be divided to the angle or canthus of the soft walls of the mouth, which is at the front of the masseter muscle. At this point, the greatest amount of force is gained, since the weight is thus brought immediately to the power, which would not be the case were the sectorial situated much in front of the masseter. On the other hand the sectorial could not be situated farther back, since it would then be inaccessible to a carcass or mass too large to be taken into the mouth.

The position of the sectorial tooth being thus shown to be dependent on that of the masseter muscle, it remains to ascertain a probable cause for the relation of the latter to the dental series in modern Carnivora. Why, for instance, were not the last molars modified into sectorial teeth in these animals, as in the extinct *Hyaenodon*, and various *Creodonta*. The answer obviously is to be found in the development of the prehensile character of the canine teeth. It is probable that the gape of the mouth in the Hyaenodons, was very wide, since the masseter was situated relatively far posteriorly. In such an animal the anterior parts of the jaws with the canines had little prehensile power, as their form and anterior direction also indicates. They doubtless snapped rather than lacerated their enemies. The same habit is seen in the existing dogs, whose long jaws do not permit the lacerating power of the canines of the *Felidæ*, though more effective in this respect than those of the *Hyaenodons*. The usefulness of a lever of the third kind, depends on the approximation of the power to the weight; that is, in the present case, the more anterior the position of the masseter muscle, the more effective the canine teeth. Hence it appears that the relation of this muscle to the inferior dental series depended originally on the use of

the canines as prehensile and lacerating organs, and that its insertion has advanced from behind forwards in the history of carnivorous types. Thus it is that the only accessible molars, the fourth above and the fifth below, have become specialized as sectorials, while the fifth, sixth, and seventh have, firstly, remained tubercular as in the dogs, or, secondly, have been lost, as in hyænas and cats.

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GRIEF IN THE CHIMPANZEE.

BY ARTHUR E. BROWN.

SOME months ago I called attention in the "Notes" of the NATURALIST to several evidences of a high degree of mental power on the part of the chimpanzee. One of the pair which, at that time, was in the Philadelphia Zoological Garden, has since died, and the behavior of the surviving one on that occasion appears to me to bear somewhat on the acquired nature of the physical means by which our strongly excited emotions find relief, as well as on the origin of those emotions themselves.

Among the lower animals, with the exception of some domesticated varieties, any striking display of grief at the death or separation from an animal to the companionship of which they had been accustomed, has rarely been observed, and although a few statements of such occurences have been made by different authorities, it is probable that the feeling of individual association, or friendship—if the term may be so used—partakes too much of an abstract nature to be sufficiently developed in them to retain much of a place in memory when the immediate association be once past. This would seem to be the case even in one of the strongest of animal attachments—the maternal instinct—in which the direct presence of the offspring, acting as a stimulus, calls forth the emotion of the mother, which, strongly rooted as it appears to be, contains much of a reflex nature and ceases on the disappearance of its cause. And here let it be said, that although the instinct of maternity and the sentiment of friendship perhaps differ widely in their origin, yet in their manifestations they are so nearly alike that the reverse feelings excited by any violence done to them, need not and probably do not differ much in kind.

With the chimpanzee, the evidences of a certain degree of genuine grief were well marked. The two animals had lived together

for many months, and were much attached to each other; they were seldom apart and generally had their arms about each other's neck; they never quarreled, even over a pretended display of partiality by their keeper in feeding them, and if occasion required one to be handled with any degree of force, the other was always prepared to do battle in its behalf on the first cry of fright. After the death of the female, which took place early in the morning, the remaining one made many attempts to rouse her, and when he found this to be impossible his rage and grief were painful to witness. Tearing the hair, or rather snatching at the short hair on his head, was always one of his common expressions of extreme anger, and was now largely indulged in, but the ordinary yell of rage which he set up at first, finally changed to a cry which the keeper of the animals assures me he had never heard before, and which would be most nearly represented by *hah–ah–ah–ah–ah*, uttered somewhat under the breath, and with a plaintive sound like a moan. With this he made repeated efforts to arouse her, lifting up her head and hands, pushing her violently and rolling her over. After her body was removed from the cage—a proceeding which he violently opposed—he became more quiet, and remained so as long as his keeper was with him, but catching sight of the body once when the door was opened and again when it was carried past the front of the cage, he became violent, and cried for the rest of the day. The day following, he sat still most of the time and moaned continuously—this gradually passed away, however, and from that time he has only manifested a sense of a change in his surroundings by a more devoted attachment to his keeper, and a longer fit of anger when he leaves him. On these occasions it is curious to observe that the plaintive cry first heard when the female died, is frequently, though not always made use of, and when present, is heard towards the close of the fit of anger. It may well be that this sound having been specialized as a note of grief, and in this case never having previously been called into use by the occurrence of its proper emotion, now finds expression on the return of even the lesser degree of the same feeling given rise to by the absence of his keeper, and follows the first outbreak of rage in the same manner as the sobbing of a child is the natural sequence of a passionate fit of crying. It may be noted too, that as his attachment to his keeper is evidently stronger than when there was another to divide with him

the attention which they received, the grief now caused by the man's absence would naturally be much stronger and a more exact representation of the gestures of grief would be made.

Notwithstanding the intensity of his sorrow at first, it seems sufficiently evident that now a vivid recollection of the nature of the past association is not present. To test this a mirror was placed before him, with the expectation that on seeing a figure so exactly like his lost mate, some of the customary signs of recognition would take place, but even by caressing and pretending to feed the figure in the glass, not a trace of the expected feeling could be excited. In fact, the only visible indication of a change of circumstances is that while the two of them were accustomed to sleep at night in each other's arms on a blanket on the floor, which they moved from place to place to suit their convenience, since the death of the one, the other has invariably slept on a cross-beam at the top of the cage, returning to inherited habit and showing, probably, that the apprehension of unseen dangers has been heightened by his sense of loneliness.

On looking over the field of animal emotion it seems evident that any high degree of permanence in grief of this nature belongs only to man; slight indications of its persistence in memory are visible in some of the higher animals and domesticated races, but in most of them the feeling appears to be excited only by the failure of the inanimate body, while present to the sight, to perform the accustomed actions.

The foundation of the sentiment of grief is probably in a perception of loss sustained in being deprived of services which had been of use. An unrestrained indulgence in an emotion so powerful as this has become in its higher forms, would undoubtedly prevent due attention to the bodily necessities of the animal subjected to it; in man, its prostrating effects are mainly counteracted by an intelligent recognition of the desirability of repairing the injury suffered, and in him, therefore, the feeling may exist without serious detriment to his welfare, but among the lower animals it would seem probable that any tendency to its development would be checked by its own destructive effects—the feeling, for instance, would most frequently occur on the death of a mate—a deep and lasting grief would then tend to prevent a new association of like nature and would thus impede the performance of the first function of an animal in its relation to its kind—that of reproduction.

EXPERIMENTS WITH PYRETHREUM ROSEUM IN KILLING INSECTS.

BY W. L. CARPENTER, U.S.A.

IN the August number of the AMERICAN NATURALIST appeared an article on the carpet-beetle, by J. A. Lintner, in which the statement was made, as nearly as I can now remember, that "although he had never used *Pyrethrum roseum* as an insect exterminator, he had no doubt that it would prove unavailing if applied to the destruction of the *Anthrenus.*" As it seemed unfair to condemn without a trial what is generally regarded as a useful insect poison, I resolved to test it experimentally; and now present the result of several trials with different orders of insects.

The insects were placed under a tumbler, which was slightly raised to admit fresh air, and a small quantity of the *Pyrethreum roseum*, or Persian Insect Powder of commerce, introduced on the point of a pen-knife. The movements of the insects brought them in contact with the powder, which readily adhered to the body; in attempting to remove it from their appendages a few particles would be carried to the mouth and thus incorporated in the juices of the stomach with fatal effect.

A honey-bee became perfectly helpless in fifteen minutes, a mud-wasp in eight minutes, a small species of ant in five minutes; a small species of *Pyralidæ* became helpless in twenty minutes; the large *Papilio asterias* resisted the effects of the drug for over one hour, and upon being released seemed to recover, but died next day. A larva of one of the *Noctuælitæ* did not seem susceptible, its jaws were repeatedly filled with the powder, which it invariably ejected by throwing out its juices; at the end of two hours it was still able to crawl feebly. A house-fly became helpless in ten minutes, a mosquito in fifteen minutes, a flea in three minutes.

In experimenting upon the *Coleoptera*, an insect as nearly the size of the carpet-beetle as could be found was secured in *Diabrotica duodecim-punctata*, an abundant species here. It was easily affected and became helpless in twelve minutes. A small pinch placed in the jaws of a large *Carabus* stopped locomotion in thirty minutes. The *Hemiptera*, owing to their peculiarly shaped mouths, were enabled to vigorously resist the baleful influence.

A species of *Coreus* was active at the end of two hours, but was ultimately overcome. A large sized katydid was deprived of motion at the end of ten minutes; *Caloptenus spretus* likewise in eighteen minutes. A dragon-fly (*Libellulidæ*) died in one hour. Spiders succumbed in one hour and fifteen minutes. The scent from the powder did not produce any bad effect upon insects subjected to its odor where actual contact was not possible. But when caried to the maxillæ or mandibles, the effect is to produce complete paralysis of the motor nerves. The legs are paralyzed in regular order, commencing with the first pair; insects will sometimes live for days in this condition, but death ultimately results from the introduction into the mouth of the smallest quantity. These experiments prove that all insects having open mouth parts are peculiarly susceptible to this powerful drug. And as a result, the writer does not hesitate to recommend the powder to housekeepers as an infallible agent in destroying the carpet-beetle and preventing its ravages. Twenty-five cents' worth of powder liberally sprinkled upon the floor before putting down a carpet, and afterward freely placed around the edges and never swept away, will suffice to preserve a large sized carpet. No ill effects from its use need be feared by the household, since if applied in this way it will be only poisonous to all kinds of insects.

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VALENTINE.

BY F. E. W.

APPLE buds and blossoms bourgeon
All the hill-side over;
Rare and sweet the pledge and presage
Nature gives her lover.

Buds will blossom, blossoms wither
In the summer's sun;
Trees will blush with rosy fruitage
When the summer's done.

Harvest-time will come and gather
Fruits and yellow sheaves;
Bud and flower and fruit will vanish;
Left to us, the leaves!

Leaves or blossoms—what doth matter?
  Phases of one thought;
Leaf in spring is fruit in autumn,
  Bud-and-blossom bought.

Earth has tree and fruit within it;
  Life and thought, the clod;
Stones spring up to love and duty
  From the sun-kissed sod.

February 14th.

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RECENT LITERATURE.

Comstock's Outline of General Geology.[1]—This neat little volume of 80 duodecimo pages, is peculiar and interesting, as it occupies a novel position among the many aids now furnished to the student of this most comprehensive branch of physical science. In his brief preface, the author explains its character, as an amplified syllabus of his elementary lectures to a mixed class in the University, who are required to gain a general familiarity with the facts and principles of geology, before they can enter either of the more extended courses, on Palæontology and on Economic Geology, given at Cornell. It is designed as a handbook of classified statements and references, to be used in connection with lectures on the one hand and with collateral reading on the other; and a blank leaf is bound in between every two pages of text, for diagrams, memoranda, etc. The general arrangement of topics is similar to that of Dana's Manual, save that Dynamical Geology precedes Historical. Under each minor division, is given an exceedingly concise statement of the facts and laws of that part of the subject, as recognized by the best authorities, and generally also a brief notice of other or older views. This is followed by a series of references, made by numeral figures, to the Reference List at the close of the book, in which about one hundred and fifty works, both general and special, including articles in scientific periodicals, monographs, etc., of particular value, are arranged, frequently with a few words of estimate, guidance, or caution, for the student.

It will readily appear, from the mere statement thus given, that the hand-book of Prof. Comstock's has great value, if only for its references, apart from its condensed and carefully classified summaries of fact. As stated in the preface, some parts of the subject are treated more fully than others. We may instance the

[1] *An Outline of General Geology*, with copious references. Designed for the use of both general and special students. By Theodore B. Comstock, B.Ag., B.S., in charge of the Department of Geology, Palæontology and Economic Geology, in the Cornell University. Ithaca, N. Y.: University Press, 1878.

section on Heat as a geological agent, Prof. Comstock's classification of Igneous and Metamorphic rocks, that on Tertiary mammals, and the closing section, upon Prehistoric Archæology. But the general scope and adaptation of the work are excellent, if its purpose be borne in mind; viz., to aid the student in holding together the knowledge gained from books and lectures, until in the course of time and practice, it can grow up into a connected system in his own mind, and become a permanent possession. It would be easy to point out things that might be added; but were the work enlarged much, it would lose the character which it now has, of an "Outline," and become what it is not designed for, a text-book. Prof. Comstock deserves great credit in our judgment, for so good and careful a presentation of the principal facts and laws of his department, prepared under great stress of professional labors at the University, in the sadly vacant place of the lamented Hartt. In his preface, he speaks of his hesitation, from conscious imperfections, in seeking for the work a wider field than his own lecture room; but he hopes still, that it may prove of service to some other teachers and students. He has done well in giving it the possibility of this wider circulation; and we cannot but think that many will thank him for having done so. We would advise any student who means to be systematic and comprehensive, and any teacher or young professor who would do justice to his work, to procure this little book without delay.—D. S. M.

GEGENBAUR'S ELEMENTS OF COMPARATIVE ANATOMY.[1]—This book marks an epoch in comparative anatomy, since the subject is not treated in the manner of the older works, such as those of Cuvier, Owen, and even Huxley, inasmuch as the facts concerning the comparative structure of the different organs of animals are not presented in a simply comparative manner ascending from the mere simple to the complex, but the author goes a step beyond his predecessors, and uses his array of facts as a foundation for a theory that may explain why the more complex structures have such a constant relation to the simpler. The facts recorded in this work are vitalized and interpenetrated by the principles of the theory of decent. To some this will be the main fault of Gegenbaur's work, to others, the introduction of a speculative and hypothetical thread, weaving all the facts into a connected, logical system, will enhance the value of the treatise. At all events it is time an effort should be made to combine the facts of comparative anatomy into a harmonious system, and if the hypothe-

[1] *Elements of Comparative Anatomy.* By CARL GEGENBAUR, Professor of Anatomy and Director of the Anatomical Institute, at Heidelberg. Translated by F. JEFFREY BELL, B.A., Magdalen College, Oxford. The Translation revised and a Preface written by E. RAY LANKESTER, M.A., F.R.S., Fellow of Exeter College, Oxford, and Professor of Zoölogy and Comparative Anatomy, in University College, London: Macmillan & Co., 1878, 8vo., pp. 645. $7.00.

sis used to connect the facts is true to and explains them, then the honor is due to the eminent author. At any rate until the theory of descent is cast aside as useless and erroneous, the science of Comparative Anatomy, hitherto so unwieldly and overgrown with isolated data, must be thus simplified and vivified.

The student will not find the book easy reading, and he should not take it up until he has mastered books like Siebold's admirable Comparative Anatomy of the Invertebrates, Rolleston's Forms of Animal Life, Huxley's Anatomy of the Invertebrates and Vertebrates, and some good work on human anatomy. He will then be able to appreciate the theory of the origin of vertebrate limbs from the fins of fishes, and to understand Gegenbaur's theory of the skull, which will supplant, and indeed has already, Oken's, Gœthe's and Owen's views based on the consideration of the skulls of the highly specialized bony fishes and mammals. The origin and specialization of the vertebrate column is also discussed in a clear and simple way, most valuable to the student, and so the formation of the different organs of special sense, the ear, eye and nose, as well as the rise and development of the brain.

We would especially recommend teachers of zoölogy, comparative anatomy and human anatomy to earnestly study this book, as it will aid in the difficult work of presenting the leading principles of animal morphology in a simple, condensed, logical way.

This English translation, which is on the whole well done, for the German of the original is difficult to translate, has appeared nearly contemporaneously with the improved second German edition. Gegenbaur has in this edition, removed the Brachiopoda from the Mollusca, and treated them as an independent "Phylum," equivalent to the Mollusca or Vertebrata, thus paying a silent compliment to our countryman, Morse. The Tunicates also stand as an independent Phylum or Branch. The sponges are still united with the Cœlenterates, a place which they may not hold in subsequent editions. The illustrations are choice, the typography excellent, and we would recommend the work as the most stimulating, suggestive and philosophical treastise the advanced student can find.

SCHMARDA'S ZOÖLOGY.[1]—This is on the whole an excellent compendium of zoölogy, valuable for the lengthy introductory matter, relating to the following subjects in general zoölogy; inorganic and organic substances, statics and dynamics of formed material, histology, physiology, development, psychology, the geographical distribution of animals, methods of study, and the principles of zoölogical classification. The systematic portion begins with the lowest Branches and ascends to the highest, the author

[1] *Zoölogie.* Von LUDWIG K. SCHMARDA. Zweite umgearbeitete Auflage. I. Band. mit 324 Holzschnitten, 1877. II. Band. mit 385 Holzschnitten, 1878. Wien. 8vo, pp. 486, 727.

adopting seven "Divisions" or Branches, *i. e.*, the *Protozoa*, *Cœlenterata*, *Echinodermata*, *Vermes*, *Condylopoda* (Arthropoda), *Mollusca*, and *Vertebrata*.

The illustrations are numerous, very well engraved and printed, and most of them seem original and expressly designed for this work. The bibliography is full enough for the purposes of the work, and there is a voluminous index. The presswork, and paper, and wood cutting is above the average of work done in Vienna.

CONGRESSIONAL RECORD, FEB. 12.—GEN. GARFIELD ON GOVERNMENT SURVEYS.—The remarks of Gen. Garfield before the House of Representatives in committee on Tuesday last, on the subject of the United States Geological surveys, deserve notice. This is especially due, because Gen. Garfield has always been friendly to the scientific enterprises of our government. But on this occasion he presents himself in a different light, for while not desiring to be thought to be attacking the surveys, he really places himself in opposition to the essential basis of their work, viz., pure science. He seems to entertain the idea that pure science is one thing, and economic science another; and that while the government may encourage the latter by pecuniary aid, it should not assist the former. Now it cannot be too strongly insisted that the two things here distinguished, are one and inseparable, and that economic science is largely pure science applied to practice, and that without pure science, it could not exist. For instance, a most important aid to mining prosperity is geology; but geology cannot exist without paleontology; yet paleontology must be regarded as in itself inapplicable to human economy. But on this science rests the determination and identification of rock strata everywhere. Now paleontology is itself impossible without zoölogy, a science of all others generally esteemed the most useless. Gen. Garfield's distinction is impossible. It is true that the General may derive some aid and comfort from Maj. Powell's report to the Secretary of the Interior, on the subject of the surveys, but the sentiments of that document are condemned by the scientific men of the country.

Gen. Garfield then says that science like religion should be left to be developed by "the people," and that government support works the same kind of injury to scientific progress that it does to religion. He then goes on to employ the following remarkable expressions: "Generally the desire of our scientific men is to be let alone * * and not to have the government enter the lists as the rival of private enterprise." "* I believe we have spent a large sum of that money upon an unwise system, and in a way which has tended to discourage the private pursuit of science by our people. We have made the government a formidable and crushing competitor of private students of science **." We suspect that such views will astonish the scientific men

of the country. They are certainly beyond precedent extraordinary. The difference between state support for religion and science is world-wide. Theology is matter of opinion, and as such governments cannot interfere with it; science is matter of fact, and in so far as it is fact of vital importance, it is the business of governments to develop it as they are bound to see that ignorance and illiteracy do not prevail among their people. And it is not always appreciated, in view of the amount of knowledge that has been developed in the world, how little of it touches as yet, the deepest problems of human life, and how much therefore remains to be done. It should also be remembered that our educational system depends for its supply of fact on the labors of scientific men; and that therefore government aid cannot be more judiciously expended than in enabling scientific men to bring forth their results.

We deny squarely that there is any such rivalry as Gen. Garfield imagines to exist between the government and the private student. Rivalry there may be between individuals, but as these pursuits do not yield pecuniary rewards, but are for the public good, such rivalry is beneficial, and should be encouraged. As to the supposition implied by Gen. Garfield's remarks, that government aid gives a presumption in favor of the views of scientists employed by government, it is quite out of the question, and indicates a wrong apprehension of the spirit of science. In this field every man's work stands on its own merits, no matter who or where he be. The idea that any scientific man deprecates government aid to science, is as false as it new. The idea of government being a "formidable and crushing competitor" of science, is very curious. Who could have originated such a thought we cannot conceive, unless it be some pseudoscientist whose estimate of scientific reputation is determined by the official position a man holds, rather than by the quality of the work he does. Most preposterous of all is the remark that aid from government has tended to discourage private pursuit of science by our people! We venture to say that our government surveys have done more to *encourage* the pursuit of science by our people than all other causes combined. It has not only encouraged it in this country, but in Europe, so effectively have the surveys been conducted. The desire of the people for their publications is such that the editions are never large enough to supply the demand. The students of science everywhere regard them as one of the grandest features of our country and time.

But Gen. Garfield has not escaped self-contradiction. He is in favor of government aid to "inquiries which in consequence of their great magnitude and cost cannot be successfully made by private individuals." Here the honorable member reaches the kernel of the matter. It is precisely enterprises of the kind to which he refers which engage the attention of the United States

Surveys. The explorations cannot be sustained by private individuals, and no private person can defray the expenses of the necessary publication. Labor is secured here at a cheaper rate by the government than in any other field, for salaries are small, and much work is done gratuitously. Students as a rule are poor, and the number of rich men engaged in its pursuit is small indeed. To withdraw government aid is to destroy a most useful competition, and to leave many departments at least in the hands of those few rich men.

But in further self-contradiction, Gen. Garfield gives qualified support to the proposed new organization of the government surveys by which all those at present in existence are to be abolished, and a single organization placed in its stead. Now the wholesome "competition between mind and mind," which he desires to encourage, could not be more effectually suppressed than by this method. As the surveys are now organized, they stimulate each other, offer a wider field for the development of science, and furnish a supply of intellectual food from which the text-books of the next half century will be drawn. And Gen. Garfield desires this work practically suspended, and the United States to retire from the position which she now holds in the commonwealth of nations, as a patron and producer of knowledge for her people.—*Philadelphia Bulletin.*

RECENT BOOKS AND PAMPHLETS.—Notes on the Aphidæ of the United States, with descriptions of species occurring west of the Mississippi. By C. V. Riley and J. Monell. Extracted from the Bulletin of the U. S. Geological Survey, F. V. Hayden, U. S. Geologist-in-Charge. Washington, Jan., 1879. 8vo, pp. 32, 2 plates.

Catalogue of the Publications of the U. S. Geological and Geographical Survey of the Territories. F. V. Hayden, U. S Geologist. 3d edition, revised to Dec., 1878. Washington, Government Printing Office, 1879. 8vo, pp. 52.

Notes on the Natural History of Fort Macon, N. C., and vicinity (No. 5). By Drs. Elliott Coues and H. C. Yarrow. (From the Proceedings of the Academy of Natural Sciences, Phila., August, 1878) 8vo, pp. 19.

Die Orthopteren-Fauna Istriens. Von Dr. Hermann Krauss. (Aus dem LXXVIII. Bande der Sitzb. der k. Akad. der Wissensch. I. Abth. Oct. Heft. Jahrg, 1878.) 8vo, pp. 90, 6 plates.

The Quarterly Journal of Conchology, Vol. I, No. 17, Nov., 1878. London, Hardwicke & Bogue. Price one shilling. 8vo, pp. 32.

Bulletin of the United States National Museum. No. 1-2, Contribution to North American Ichthyiology. No. 3, A—On the Distribution of the Fishes of the Allegheny region of South Carolina, Georgia and Tennessee, with descriptions of new or little known species. By David S. Jordan and Alembert W. Brayton. B—A Synopsis of the family Catostomidæ. By David S. Jordon. Department of the Interior, Washington, Government Printing Office. 1878, 8vo, pp. 233.

United States Geological Exploration of the Fortieth Parallel. Systematic Geology. By Clarence King. Illustrated by XXVIII plates and XII Analytical Geological Maps, and accompanied by a geological and topographical Atlas. Washington, 1878. 4to, pp. 803.

Wanderings in South America, the north-west of the United States and the Antilles, in the years 1812, 1816, 1820 and 1824; with original instructions for the perfect preservation of Birds, etc., for cabinets and natural history. By Charles Waterton, Esq. New edition. Edited with biographical introduction and explanatory index, by the Rev. J. G. Wood. With 100 illustrations. London, Macmillan & Co., 1879. 8vo, pp. 520. $6.50.

Notes on the Life and Character of Joseph Henry. Read before the Philosophical Society of Washington. By James C. Welling, Oct. 26th, 1878, (Extracted from the Bulletin of the Society.) 8vo, pp. 28.

The Natural History of the Agricultural Ant of Texas. A monograph of the habits, architecture and structure of Pogonomyrmex barbatus. By Henry Christopher McCook. Author's edition. Academy of Natural Sciences of Philadelphia, 1879. 8vo, pp. 306, 24 plates.

Report of the British "Transit of Venus." Expedition to Kerguelen island. Zoölogy. Seals and Cetaceans. By William Henry Flower, F.R.S. 4to, pp. 6. ? date. From the author.

Preliminary Report of the Field Work of the U. S. Geological and Geographical Survey of the Territories for the season of 1878. By F. V. Hayden. 8vo. pp. 29. Government Printing Office, Washington. From the author.

Christian Gottfried Ehrenberg, ein Tagewerk auf dem Felde der Naturforschung des neunzehnten Jahrhunderts. Von Johannes Hanstein. Bonn, 1877. From the author.

Bemerkungen über den Vorderarm niederer Wirbelthiere. Von C. Gegenbaur. 8vo, pp. 314–319. Heidelberg, July, 1877. From the author.

Ueber das Koppskelet von *Alepocephalus rostratus* Risse. Von C. Gegenbaur. 8vo, pp. 42, Taf. II. (Ext. from Morph. Jahrbuch 4, Suppl.) Heidelberg, Jan., 1878. From the author,

The Palæontologist, No. 3, Jan. 15., 1879. 8vo, pp. 17–24. By U. P. James. Cincinnati, Ohio. From the editor.

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Catalogue of the birds of Antigua and Barbuda. From collections made for the Smithsonian Institution, by Mr. Fred. A. Ober, with his observations. By. Geo. N. Lawrence. (Ext. Proc. U. S. National Museum.) 8vo, pp. 232–242. Published Dec. 9, 1878. From the author.

Description of a New Species of Cypselidæ of the genus Chætura. By Geo. N. Lawrence. (Ext. from Annals of the N. Y. Acad. Sci:, Vol. I, No. 8.) 8vo. pp. 255–6. Read Nov. 11, 1877. From the author.

Thirteenth Annual Report of the Commissioners on Inland Fisheries, for the year, ending Sept. 30, 1878. 8vo, pp. 63. (Public Document, No. 34.) Boston, 1879. From the Commissioners.

Seventh Report of the State Entomologist (Walsh, 1; LeBaron, 4; Thomas, 2), on the Noxious and Beneficial Insects of the State of Illinois. Second Annual Report. By Cyrus Thomas, Ph.D., State Entomologist. 8vo. pp. 290. Springfield Ill.. D. W. Lusk, State Printer, 1878. From the author.

Address of Prof. Augustus R. Grote, Vice-President Section B, before the American Association for the Advancement of Science, at the St. Louis Meeting, 1878. (Ext. from the Proc. of the Association, Vol. XXVII.) 8vo, pp. 20. Salem, Mass., 1878. From the author.

On the Classification and Distribution of the Cray-fishes. By T. H. Huxley, Sec. R. S., V.P.Z.S. (Ext. from Proc. Zoöl. Soc., London, June 4, 1878. 8vo, pp. 751–788. From the author.

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GENERAL NOTES.

BOTANY.

On Nomenclature.—"I think it is about time that the notion that a species must necessarily be named after some peculiarity that it possesses, should pass into the limbo of exploded ideas." This passage, in the article "Walks Round San Francisco," in the Naturalist, December, 1878, page 791, induces me to

express my opinion on the use of personal names in scientific nomenclature.

Linnæus in his Philosophia Botanica proposes: "Nomina generica ad botanici *optime meriti* memoriam conservandam constructa sanite servanda sunt. Hoc unicum et summum premium laboris sanite servandum et *caste dispensandum*." I agree with this proposition. Generical names established for the memory of the *most deserving* botanists should be kept sacred and imparted *abstemiously*.

Like the preacher, who warned his congregation to act according to his saying not according to his doing, Linnæus did not always strictly follow his own maxim, but the rule he proposes is a good one. Though I would prefer even for genera characteristic names, I would not blame an author who likes to honor the *most deserving*[1] botanists by baptizing genera after their names.

In regard to specific names, Linnæus advises against the use of names of persons or countries. He says: "Inventoris vel alius cujusquinque nomen in differentia non adhibeatur. Locus natalis species distinctas non tradit. Differentia specifica continet differentiæ *notas essentiales*." Indeed a species that has not one character by which it can be distingushed from its congeners is not worth being called a species. In contradiction to this rule the Commission of European botanists, appointed by the International Congress at Paris, 1867, allowed the use of personal names. It is true what De Candolle says in the preface to those rules, that the Linnæan rules of nomenclature are obsolete, but just in this case I think Linnæus was right, and if that commission had considered how much personal names were misused and are misused in our time more than ever, then articles 32, 33 and 36 would not have passed in their present form. Of said misuse I could name many cases, but I take only one: Scheele published in *Linnæa* 114 new Texan plants, among which I count twenty-one *Rœmeriana*, fourteen *Lindheimeriana*, one *Grisebachii* and twenty *Texana*. When we deduct from the rest those which had already been described, more than half of all the new species got names which mean nothing more than a cheap compliment, worthless to a true scientist. The owners of the three above-mentioned personal names are botanists indeed (whether *most deserving* I am not competent to decide), but how often has a species to bear the name of a man who finds a new species as a blind hen finds a grain, or the name of the military commander of an expedition the collecting botanist was a member of, or the name of a friend of the species maker, whose connection with the object is looser yet. The most awkward thing is that, when a botanist mistakes a really new species for a known one, his mistake is rewarded by giving his name to the same new species which he did not recognize as such.

[1] Many are called, but few chosen.

There is another point in which I do not agree with the established rules: that is the right of priority, which the author of the "Walks" wishes to be extended even to wrongly spelled or ungrammatical names. This right of priority is the real source of premature publications and of the accumulation of synonyms. For example: Bertoloni, a respectable Italian botanist, professor in Bologna, receives a number of Alabama plants; he describes and names many new species which are known and named before. The trouble is, he is not enough acquainted with the North American flora and too hasty to leave the publication of new American species to an American author, who has at his disposition a greater quantity of specimens, which are necessary for a correct description. Now amongst those plants was perhaps a single poor specimen of *Petalostamon corymbosum.* Instead of laying it aside he describes it as the type of a new genus (*Gavesia*) in the order of Compositæ. How often in the same way we see a man who is not master of the synopsis, who does not know what is known, push his name before the scientific public, not from zeal for science, but from desire to see his "mihi" behind a new created species. Then true scientists have the trouble to clear the stable.

To meet the case at once there should be appointed an international committee, an Areopagus, in which the most prominent botanists should decide on the value of each specific name. Free competition would be left open, but the author of a name would have the risk of refusal. Better yet—we, the humble mortar carriers, should give over to the masters of systems all the pebbles and diamonds we find, and leave to them the task of assorting. The arena of science is wide, and there is chance enough to search for laurels outside of systematic botany.

And now one word about wrongly spelled or ungrammatical names. The Parisian congress has acknowledged the right to correct such bad names, and that is right. The best scholar may inadvertently make a mistake, and he will not be offended by being corrected. It is right to read *Astragalus aboriginum* instead of *aborigenorum*, and *Scytonema simplex* instead of *simplice.—Fred. Brendel.*

Aspidium boottii Tuckerman.—As the following note, prepared for my Catalogue of the "Davenport Herbarium" of North American Ferns, is supplementary to my paper on "*Aspidium spinulosum* Swz., and its varieties," published in the Naturalist for November, 1878, I offer it here in advance of publication.

In my paper on "*Aspidium spinulosum* Swz., and its varieties" (Amer. Nat., l. c.) I was led to consider *A. boottii* Tuckerman and *A. remotum* Braun as identical, by an examination of a specimen of the latter, at Cambridge, from Braun's herbarium, and to credit Braun's name with being the oldest, on the authority of remarks in Hooker's "British Ferns," t, 22, but since the pub-

lication of my paper I have endeavored to learn the exact date of the publication of Braun's name, with the following result:

The record, so far as it appears from all accessible authorities, is, that in 1834 Braun first discovered in a mountain valley near Baden specimens of a fern, growing with *Aspidium filix-mas* and *A. spinulosum* (*dilatatum*) that he at first referred to *Aspidium rigidum* as a variety of that species (var. *remotum*), but which he afterward designated as a species, under the name of *Aspidium remotum*. Later he appears to have regarded it as a hybrid form between *A. filix-mas* and *A. spinulosum*, but finally, according to Milde (Fil. Eur. et Atl., 1867), considered it a form of *Aspidium filix-mas*.

Braun, however, does not appear to have published any description, and unless, as Mr. Watson suggests, he may have given the name previously in some catalogue of the Lipsic Garden, the name *Aspidium remotum* does not appear until about 1850, when it occurs for the first time in "Verjüngung," Freiburg, 1849–50.

On the other hand, Tuckerman's name and description was published in *Hovey's Magazine* for 1843, which entitles it to the right of priority, and justifies my retaining it on stronger grounds than those given in my paper on *A. spinulosum*.

The question of identity, however, still remains in doubt. The two ferns have generally been regarded as identical, by English authors, but Milde held the opinion (Nova Acta, 1858) that *A. remotum* had nothing whatever in common with *A. boottii*, and as his opinion was based on a careful study of the anatomy of the two plants, it is entitled to the very highest consideration.

In the face of the opinion of so careful and thorough an investigator as Milde, it is extremely unsafe for any one to hazard an opposite opinion, without a most careful and searching investigation, conducted on the same principles as those made by that eminent cryptogamic botanist; but I cannot forbear expressing the opinion that some of the external characters pointed out by Milde as separating the two ferns, are not altogether reliable, as, for example, the comparative length of the stipe, the chaffiness, or stoutness of the rachis, and the degree of pinnation in the frond, all of which characters certainly vary greatly in different specimens of *A. boottii*.

The difference, however, pointed out in the number of fibre-bundles in the stipe of *A. remotum* (7) as compared with the similar structure of the stipes in *A. spinulosum* and its forms (5 fibre-bundles) is a most important one, and one not to be lightly overlooked.

According to Milde, also, the indusium in *A. remotum* is without glands, whereas in *A. boottii* the indusium is finely glandular. But as these glands frequently disappear early, and are not always present after the indusium contracts, we cannot tell how much importance to attach to Milde's statement, without knowing ex-

actly in what state his specimens were when examined. Milde, himself, in another part of the same work, when speaking of *A. spinulosum* and *dilatatum*, apparently regarded the presence or absence of glands on the indusium as unimportant.

I shall discuss this question more fully hereafter; for the present I can only say that the specimen of *A. remotum* at Cambridge, from Braun's herbarium—the ticket is apparently in Braun's handwriting and bears date "Aulich, Sep. 1859"—appears to me identical with our *A. boottii!* If detached from the sheet and sent out for that fern, it would be generally received without question.

But in whichever way the question of identity is finally decided, its determination either way cannot affect the position of Tuckerman's name, which dates with Braun's earliest name (*Aspidium rigidum*, var. *remotum*, A. Br. in Dœll's Rheinische Flora, 1843) and is the oldest specific name on record. The name *Aspidium boottii* Tuckerman, therefore, must remain undisturbed.

I am greatly indebted to Mr. Sereno Watson, of Cambridge, and to Prof. Eaton, for their kindness in aiding me to look up authorities. (Geo. E. Davenport in Catalogue of the "Davenport Herbarium" of North American Ferns, Mass. Hor. Soc. ined. MEDFORD, Mass., Jan., 1879.)

Remarks—In my paper on *Aspidium spinulosum* I was inadvertently led into two errors of authority that I wish to correct here. *Aspidium spinulosum* var. *dilatatum* and *A. spinulosum* var. *boottii* should both be followed by Gray as authority, in place of "D. C. Eaton in Gray's Manual."

BOTANICAL NEWS.—Sir J. Hooker, in his recent address to the Royal Society, refers to the remarkable theory of Schwendener, now ten years old, affirming that the lichens consist of ascomycetal fungi united in a commensal existence with algæ. Indeed Stahl has manufactured such lichens, as *Endocarpon* and *Thelidium* by juxtaposition of the appropriate algæ and fungi. That minute plants (Bacillus) may occasion disease is apparently shown by the fact that the dried blood of horses that had died of the "Loodiana fever," in India, on being sent to England, there afforded seed from which a crop of *Bacillus anthracis* has been grown, which justified its distant pathological origin by reproducing the disease in other animals.

That gigantic undertaking, the Flora of Brazil, begun by Von Martius, is now being carried on by Eichler of Berlin, under the liberal auspices of the Emperor of Brazil. A little over a year ago Bentham's Flora of Australia was completed. It describes eight thousand species of plants.

Mr. A. W. Bennett contributes to *Nature* an account of the experiments of Rev. G. Henslow on the absorption of water by the leaves of plants, forming a sequel to and confirming those of Boussingault. That plants absorb water by their leaves, and that

gardeners should therefore continue to water plants by sprinkling their leaves, seem well established facts.

The *Bulletin* of Hayden's U. S. Geological Survey, Vol. IV, No. 4, contains a catalogue, by Prof. J. W. Chickering, of Phænogamous and vascular Cryptogamous plants collected during the summers of 1873 and 1874, in Dakota and Montana, along the forty-ninth parallel, by Dr. Elliott Coues, U.S.A.; with which are incorporated those collected in the same region at the same time, by Mr. George M. Dawson.

Trimen's *Journal of Botany* contains articles on a monandrous Cypripedium, by S. L. M. Moore, and a further note on the structure of Composites, by M. T. Masters. Braun's article on the vegetable remains in the Egyptian museum at Berlin, is translated from the Zeitschrift für Ethnologie, the first part appearing in the January number.

The *Bulletin* of the Torrey Botanical Club contains an account among other notes, by Prof. Gray, of a sporting *Trillium grandiflorum*, and of an *Agaricus* with the odor of chlorine, by C. F. Austin.

In the *Botanical Gazette* G. Vasey describes a new *Panicum*, *P. littorale* from Mobile. J. M. Coulter contributes an article on the flora of Northern Indiana.

ZOÖLOGY.[1]

NOTE ON THE HAIRY-TAILED MOLE, SCALOPS BREWERI OF AUTHORS.—The earliest description of a mole, referable to the genus *Scapanus* and to the species subsequently named "*Scalops breweri*" by Bachman, is that given by Harlan, Fauna Americana, 1825, p. 43, under the name of *Talpa europea*—he wrongly supposing that it was the common mole of Europe. He does not state whether he described an American or a European specimen; and the general drift of his remarks indicates that he compiled, at least in part, from some staple description of *Talpa europea*. But it is evident that he really had in view an American mole, which he recognized as distinct, both generically and specifically, from our common *Scalops aquaticus*.

That this is no other than the *Scapanus* is shown by the dental formula of forty-four teeth, which is applicable neither to *Scalops* nor to *Talpa*; and the rest of his description is incompatible in no respect with *Scalops "breweri*," which so closely resembles *Talpa europea* in superficial appearance that it has not seldom been mistaken for the latter. That there is no doubt in the case is further witnessed by Audubon and Bachman, who state (Quad. N. A. III, p. 219) that "Harlan had described the skull of the species we have since described and figured as *Scalops breweri*, having forty-four teeth," &c.

In connection with this description, Harlan published William

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Bartram's MS. name, "*Talpa americana*," which thus antedates the trivial name "*breweri*" of Bachman. It therefore becomes necessary to know the hairy-tailed mole as *Scapanus americanus.* --*Elliott Coues, Washington, D. C.*

The Clover-seed Fly, a new Insect Pest.—At the annual meeting of the N. Y. State Agricultural Society, held at Albany in January last, J. A. Lintner, of the State Museum of Natural History, read a paper in which, among other injurious insects recently observed, he gave an account of the larvæ of an insect which had been discovered two years ago in several localities in Eastern and Northern New York, hidden within the seed-pods of the red clover (*Trifolium pratense*) and destroying the seeds. The perfect insect had not yet been seen, but the examination of the larva showed it to belong to the Cecidomyidæ, and in all probability very nearly allied to the wheat-midge, *Cecidomyia destructor.* A description of the larva was given under the name of *Cecidomyia trifolii* n. sp.

The range of this insect's depredations or the extent of its ravages was as yet unknown. In some localities in the western counties of the State of New York, the clover was so infested with it last year that it was worthless for seed. It is believed that the not infrequent failure heretofore reported of the clover-seed crop throughout the country, which has been ascribed to imperfect fertilization of the blossoms and various other causes, has been the result of the secret operations of this little insect.—*J. A. Lintner.*

The English Sparrow and our Native Song-Birds.—The introduction of the English sparrow, and the substantial disappearance of the smaller song-birds from our cities and villages, have been nearly coincident in point of time, but it does not follow that they are connected as cause and effect. The imported bird is just making its appearance in the smaller villages of Northern Ohio, where it finds the territory substantially unoccupied. Our native songsters disappeared from these localities before they came in contact with the intruders. The house wren, the summer yellow-bird, the blue-bird, the green-finch, song-sparrow, chipping-sparrow, and the vireos, were, a few years ago, abundant in all these villages; now, but few of them are seen during the season. The robin is as abundant, and as great a plunderer of our small fruits as ever. The Baltimore oriole remains. The cedar-birds come for their feasts upon the apple-blossoms in the spring, and upon the cherries in their season. The slate-colored snow-bird takes up its winter quarters with us, and the crow black-bird and the cat-bird build their nests in our ornamental trees.

It can not be supposed that the native songsters retire in anticipation of the intrusion of their foreign cousins, and some other cause for their disappearance must be sought.

In this neighborhood, the want of appropriate nesting-places

is a sufficient explanation. The forests are now all enclosed, and constitute a part of the pasture lands. The undergrowth and thick masses of shrubs, brambles, and creepers have disappeared; the most of our little swamps are reclaimed; and as these changes have occurred in the forest and field, fashion has prescribed a smooth lawn, with scattered trees and clumps of summer bedding plants around our dwellings, in place of the thick masses of shrubbery which were cultivated a few years ago. And it is the birds which found their nesting-places and their food supplies in this shrubbery and undergrowth which have most thoroughly disappeared.

The robin finds good nesting-places and an abundance of summer food; the Baltimore oriole suspends its nest from the drooping branches of the elm; and both these birds are content to remain with us. In the forest and field, where the English sparrow does not intrude, the thrushes, the warblers, the fly-catchers, finches, and black-birds are by no means as abundant as formerly. Their nesting-places are greatly restricted, their food supplies diminished, and they find no thick copses, under the cover of which they delight to hide themselves, and in which so many find a large part of their supplies of food. Their nests are more exposed, and their life is made uncomfortable by these changed conditions, and they are driven to seek homes more congenial to their habits.

A care for our forest reserves, which will protect them from the intrusion of domestic animals, and permit the renewal of the dense undergrowth which has been destroyed, and the culture of thick masses of shrubbery about our dwellings, will secure a return of the exiles, and *perhaps* a contest for the occupancy with the imported birds. We shall then learn whether they can dwell together in amity or not.—*M. C. Read*, *Hudson*, *Ohio*.

ANTHROPOLOGY.[1]

HABEL'S ACCOUNT OF ANCIENT GUATEMALAN SCULPTURES.—The Smithsonian Institution will issue, in a few days, an illustrated pamphlet of eighty-six pages, by Dr. Habel, upon a wonderful series of sculptures from Santa Lucia Cosumalhuapa, Guatemala, near the capital. It is impossible, in a brief note to epitomize a work of such great merit. We give a few of the concluding remarks of Dr. Habel in his own words:

"These sculptures of Santa Lucia Cosumalhuapa are to me the most interesting of the kind that have been preserved of the ancient inhabitants of America, furnishing as they do, unequivocal proof of the advanced culture to which their constructors had attained. Those found in other localities represent either single individuals, or groups in which the relations are obscure; but the bas-reliefs of Santa Lucia in every case but one present

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

scenes in which there are generally two actors, one of them being a mythological personage. We are introduced into the very feelings and thoughts of the people, and learn much of their modes of living.

"We are enabled to decide the progress of a people by the perfection to which they had carried the useful arts, by the advancement which they had made in the fine arts and in scientific knowledge, by their religious conceptions, and by their language, including the methods of representing it. A comparison of these also acquaints us with those things which different peoples have in common. Let us therefore compare the sculptures of Santa Lucia with those of other parts of America in these four particulars, in order that we may perceive the resemblances between their fabricators, if any exist, and form some opinion of their comparative status in culture.

"As regards the useful arts, when we consider the hardness of the material, a dark gray porphyry from the volcano of Acatenango, we are convinced that the Santa Lucian sculptors used tools of great perfection. The advancement of technical skill is further attested by the variety of manufactures represented in the sculptures, such as wood-carving, textile fabrics, shell and metal work, leather work, carved stones, etc. The elevated character of these products of industry is attested by the uses to which they were put. With the exception of sculptures nine and fourteen, there is scarcely anything which indicates clothing merely. Nearly every article which is attached to the body is an ornament, although the drapery suspended from the girdle may have been introduced to hide the genital organs. The foot also may be said to derive some slight protection from its ornamented sandal. The neck, arms, body, and legs, however, are adorned and not clothed. The ornaments of the head, and especially those of the hair, are extremely profuse, reaching often to the ground. It is worthy of notice that no part of the body is mutilated for the sake of beauty, excepting the lobe of the ear, which even in our enlightened age serves the ladies as a means of perpetuating barbarism.

"Again, the variety of forms in the same object is an indication of progress. The headdresses are greatly varied. In one instance it is a crab, in another entwined serpents, and in others it is so complicated as to remind us of the fashions in highly enlightened nations. The most lavish care was bestowed on the hair, which in very few cases indeed appears without ornament, even on the heads of immolated victims. The method of ornamentation seems to have indicated the social position of the wearer. The hair is at times adjusted to resemble a wig, but is generally braided with ribbons, adorned with rings, etc., and reaches in cues to the shoulders and below them. Other yet more complicated ornaments reach to the ankles, and even trail upon the ground,

ending in some animal form, as an eagle, American tiger, or a fish. One of these ornaments which is met with in every case is in the form of a sheathed scimitar.

"This variety is again noticable in the ornamentation of the ear, which assume the form of rings, embossed disks, tassels, etc, and of the neck, which may be a single band, a double collar, a ring with pendant tassel, or a necklace of many rows of beads or stones.

"Generally the wrist of but one hand is adorned with a bracelet, which is either made of some textile fabric or consists of rows of stone or metal beads. The other hand is inclosed in a human skull or in that of a fierce animal. If these are the skulls of immolated victims, we have here the evidence of the sacrifice of animals as well as of human beings.

"The waist above the hip, is surrounded by a broad stiff girdle, the upper portion which stands off from the body. On the back part of it is usually seen the head of a ferocious animal with open jaws replaced in one instance by a human head. From the lower edge of the forepart of the girdle descend two kinds of sashes, the one surrounding the thighs, the other tied in a bow-knot in front. The material of these sashes varies greatly. In one instance it appears to consist of leaves and flowers; in another, that of the priest, it is replaced by a serpent. A twisted band tied in a bow replaces the girdle on the waists of the immolated victim.

"The ornamentation of the leg deserves especial attention A band with pyriform pendant encircles the right leg below the knee. A single pendant is attached to the band in all cases, excepting that of the person sitting on a throne, where the entire lower edge of the band visible is occupied by six pendants. From this circumstance this person is supposed to have been the chief, or grand master —to use a heraldic term—of an order of which the others were simply knights or laymen. The occurrence of the same ornament on the neck of the figure supposed to represent the sun, indicates that an order may have existed in honor of the sun, and the members thereof may have been knights of the sun, who had their counterpart in the Virgins of the Sun in Peru.

"This instance of wearing a badge on the leg below the knee is remarkable in its resemblance to the Order of the Garter in England. It is impossible to suppose that one people imitated the other, but we have here a striking illustration of the development of similar thoughts and ideas in individuals and nations widely separated in time and space. This is further impressed in the fact that these knights only wore their distinctions on high and festive occasions, or when adoring their gods; while on ordinary occasions, as with the sick man, a simple rosette takes the place of the badge.

"The protection of the feet is greatly diversified. Exceptionally

both feet are nude, but generally the bottom of one or both feet is protected by a sole, which is rolled up more or less to cover the upper part of the foot. The toes, with few exceptions, remain unprotected, and in no instance is the covering of both feet alike.

"We come now to speak of the artistic taste of the sculptors of Santa Lucia as an indication of the superior culture of the people to whom they belonged. In the representation of natural forms we attribute the highest culture to those people who imitate nature most closely in her best manifestations. For this reason we should attribute to the ancient Greeks a very high degree of culture if we had received no other knowledge of their civilization excepting the relics of their works of art, which, when attempting to imitate nature, avoid all grotesqueness and caricature.

"In the sculptures of Santa Lucia the human form stands before us, not with ill-proportioned features, but in regular outline combined with marked expression of the countenance. The observance of these details proves a diligent study of the human body. That which does appear as grotesque, must not be attributed to a crude conception or to want of skill, but to the ornamentation, which has a barbarous luxuriance. If we examine the heads in the sculptures of Santa Lucia; we shall find that while they all possess the curved nose so characteristic of the aborigines of America, they have no stereotyped forms; on the contrary, this feature varies with the expression of the face, so as to individualize each person represented. Some of the faces are attractive on account of the quiet expression of their features; and one especially approaches very nearly to our sense of beauty. The engraving hardly does justice to the original.

"Again, just as each art passes through several stages in its progress to perfection, so among all arts there is the same gradation. Thus lyric and didactic poetry are assigned a lower place than epic poetry, and the drama is the most elevated of all. Dramatic conception can originate and be cultivated only by a people who have passed the other stages. The monoliths of Santa Lucia show that their authors had cultivated the poetic sentiment as well as sculpture; for, not only do we find that they had statuary as well as low reliefs, but we have evidence of the degree of poetical elevation to which they had attained. All of the scenes represented are dramatic, and four of them are allegorical. In the two sculptures representing sick men, the individuals are doubtless of high standing. One of them is visited by death in the shape of a skeleton, who draws the attention of the sick man to the fact of his having lived for a number of years, indicated by the signs for numerals, and that it is, therefore, time for him to depart. In the other case, the sick man is visited by the medicine man in the guise of a deer, and reminded of the moderate number of years he has lived, as indicated by the numeral signs. This *news* would cheer him with the hope of recovery.

"In each of the other two allegorical sculptures, a human being is devoured by a bird—perhaps the Bird of the Sun—as it wears the image of the sun on the breast. This myth, again, has arisen independently in many lands.

"The advancement of a people is also said to be measured by their religious conceptions. If we inquire into the stage which the evolution of the religious sentiment had reached among the people of Santa Lucia, we shall find that they were passing from the adoration of the sun and other heavenly bodies to the worship of men—Anthropomorphism. Among the deities in the sculptures can still be found the sun and moon, but both represented with human forms. The entire body is not given, but only the upper, nobler part. In the images of the deities are preserved the natural human features, not disfigured by any addition of animal organs or fantastic attributes.

"The sculptures prove, alas! that human sacrifices were practised by their makers. The mode of immolation was peculiar. It was not the entrails of the victims which were dedicated to the gods, nor the heart torn from the breast and thrown at the feet of the idol; but we see here the noblest part of the body, the head, severed and presented to the deity.

"Finally, the language of a nation and the methods of representing it are valuable indications of their status in culture. The same may be said of their numeral system.

"It has been frequently affirmed that the aborigines of America had nowhere arisen high enough in civilization to have characters for writing and numeral signs; but the sculptures of Santa Lucia exhibit signs which indicate a kind of cipher writing, higher in form than mere hieroglyphics. From the mouth of most of the human beings, living or dead, emanates a staff variously bent, to the sides of which nodes are attached. These nodes are of different sizes and shapes, and variously distributed on the sides of the staff, either singly, or in twos and threes—the last named either separated or in shape of a trefoil. This manner of writing not only indicates that the person is speaking, or praying, but also indicates the very words, the contents of the speech or prayer. It is quite certain that each staff, as bent and ornamented, stood for a well-known petition which the priests could read as easily as those acquainted with a cipher dispatch can know its purport. Further, one may be allowed to conjecture that the various curves of the staves served the purpose of strength and rhythm, just as the poet chooses his various metres for the same purpose.

"In the supplications of human beings this staff and its knots have a simple form, in the speeches of death the bends are angular; but the staves emanating from the deities are exceedingly complicated, and proceed, not from the mouth, but from the head or neck. To the variously bent and ramified staves of the deities,

divers flowers, fruits, and mythological emblems are attached in addition to the ordinary nodes.

"Besides the modes of writing just mentioned the sculptures exhibit another method of representing emotions and aspirations not expressible in words. It consisted in wavy ridges or lines originating either from the mouth or from the girdle of the suppliant, and uniting at the upper extremity, or separated like the conventional sign for flames. The artists of Palenque have expressed a somewhat similar conception by a figure blowing a horn, from the end of which proceed similar wavy lines to designate either the music or the escaping breath. (Stephens, Incidents of Travels, c. ii, 354.) Besides these methods of expressing thought there are, as before mentioned, hieroglyphics, chiefly a circular ridge inclosing the head of an animal or a pointed trefoil.

"In regard to the signs for numerals, it is evident that the radix of their system, whatever may have been its value, was represented by a circle, the same sign indicating zero in our system. A single horizontal line may be taken for a unit, two lines intersecting as in a Roman X, some other value, and lines shorter than the unit may be taken for fractional parts. This system of recording numbers throws some light on the question whether the ancient inhabitants of Middle America had any intercourse with the civilized nations of Europe. Evidently, if by accident or design, Egyptians, Phœnicians, Jews, or any other race had imported their civilization into America, some traces of it would be exhibited here."

ANTHROPOLOGICAL NEWS.—The following brief notices may be of interest to some: In the *Mittheilungen* der Anthropologischen Gesellschaft in Wien, Dr. M. Much has a paper (pp. 203–273) upon agriculture among the ancient Germans, in which he takes the ground that the ancestors of the present Germans were always a settled people in Germany. The paper evinces a great deal of learning. L'Evolution Sociale en Occident depuis le moyen age jusqu'à nos jours, by P. Lafitte, *Revue Occidentale*, Nov. 1878, 4 pp. Essai sur Symbolique Planetaire chez les Semites, H. Charency, *Revue Linguistique*, 1878. Bericht über die IX. allgemeine Versammlung der deutschen anthropologischen Gesellschaft, zu Kiel, 12.–14. Aug. 1878, in *Correspondenz-Blatt*, No. 10. The Races of European Turkey: Their History, Condition and Prospects, by Edson I. Clark, Dodd & Mead.

Esquisse d'une Grammaire Raisonnée de la Langue Aleoute. V. Henry. *Revue Linguistique*, Oct.–Dec., 1878. Aborigines of the Housatonic Valley, E. W. B. Canning, *Magazine of American History*, Dec., 1878. Oregon: The origin and meaning of the name, *id.*, Jan., 1879. The Wanga Plant and Voudooism, *Philadelphia Medical Times*, 1878, p. 539.

GEOLOGY AND PALÆONTOLOGY.

Mineral Wax in Utah.—Prof. J. E. Clayton of Salt Lake, has recently discovered an immense deposit of mineral wax in Southern Utah. He describes it as sixty miles long by twenty wide, in some places forming a bed twenty feet thick. It contains more or less clay in seams and layers. Prof. Newberry finds it to be ozocerite, and Prof. Wurtz has obtained from the same region zietriskisite.

Merycopater and Hoplophoneus.—Having recently had the opportunity of examining the entire dentition of the lower jaw of the *Hyopotamus guyotianus* Cope,[1] I find that it does not belong to the genus to which I referred it, but to an allied one, which appears to be undescribed. It differs from *Hyopotamus*, having but three premolars and a simple diastema. The premolars are wide, and the last has four crescentoid cones, as in the first true molar (crowns of first and second lost). Canine well developed, compressed, anterior. The cones, both internal and external have a crescentic section. The inner cones are convex on the inner side in *Gelocus*, which also differs from this form as does *Hyopotamus*, in the simple compressed form of the premolars. The present genus may be called *Merycopater*. *M. guyotianus* was as large as the white-lipped peccary.

Fine specimens of the *Machærodus brachyops* Cope (l. c. p. 10), show that it possessed an inferior tubercular tooth. It therefore belongs to the genus *Hoplophoneus* Cope. It is a very much larger species than the *H. oreodontis* Cope.—*E. D. Cope.*

The Nature of Eözoön.—Dr. Karl Möbius contributes to Palæontographica for 1878, the results of his investigations into the structure of Eözoön from Canada. He used specimens received from Drs. Dawson and Carpenter. As an expert in the study of recent *Foraminifera* (*Rhizopoda*), Dr. Möbius's opinion carries with it much weight. His conclusion is, that the columns of the Eözoön limestone which Carpenter and Dawson supposed to be the casts of a canal system of the " intermediate or supplemental skeletons," are simply casts of fissures of various and unsymmetrical shapes having no resemblance to the tubules of any organic being. They are mostly flat, and frequ ntly interrupted. The fibrous material found between the serpentine and the calçareous masses, supposed to be casts of the canals of the walls of the chambers of Eözoön, such as exist in the Foraminifera, consists of prismatic crystals of chrysotile. Dr. Möbius does not believe them to be casts of tubes, since no tube walls or interspaces can be seen by high powers either with or without polarized light.

The Age of the Laramie.—Prof. Schimper, of Strasburg,

[1] Palæontological Bulletin, 30, p. 15, Proceed. Amer. Phil. Soc. for November, 1878.

writes to Mr. Lesquereux to this effect in regard to the fossil plants of the Laramie group:

"I do not cease reviewing and studying your last magnificent publications which have given to phytopaleontology an immense forward impetus. 'Par lesquelles vous avez faite faire un pas immense à la paleophytologie.' You ask me to express my opinion on the age of your flora of the lignitic. It seems to me impossible that one can see in it anything else than a tertiary flora, unless one wishes to reverse all the data acquired by science until now. I consider this flora just as you do, as truly (franchement) eocene, not even pliocene, perhaps contemporaneous with Mt. Bolca or eocene, possibly a little more recent. It is very possible that in marine strata, intermediate to the land or lignitic deposits, one may find remains of cretaceous animals. It has been observed already many times that the modification to which the inhabitants of the land have been subjected, do not accord with those exhibited by the inhabitants of the sea. These are very often backward in their development, and this is quite natural from the slower action of the climate or climatic influence upon the inhabitants of the sea than upon those of the land. The facies of your lignitic vegetation is tertiary; it is impossible to change that. Messrs. the geologists have to decide as they may find proper."

ON THE OCCURRENCE OF A SOLID HYDROCARBON IN THE ERUPTIVE ROCKS OF NEW JERSEY.—Mr. I. C. Russell states that associated with the sheet of trap rock known as the First Newark Mountain, which traverses the central portion of the Triassic formation of New Jersey, there occurs near Plainfield, at an abandoned copper mine on the western slope of the mountain—the upper surface of the trap sheet—an amygdaloid trap passing into a metamorphosed shale. In this region it is frequently impossible to distinguish in small exposures the genuine trap from the metamorphosed shales that rest in contact with it. Many of the cavities in the amygdaloidal rock are filled with a brilliant jet black carbonaceous mineral resembling very closely the albertite of New Brunswick. These cavities are frequently tubular in shape having a length of three or four inches and usually a diameter of about a quarter of an inch. Sometimes these tubes were lined throughout by infiltration, with a coating of quartz or calcite a line or two in thickness, before the carbonaceous material was introduced. Above the amygdaloid is found a metamorphosed shale which still retains its bedded structure, and in places presents something of the usual reddish color of the unaltered shales. This altered rock is traversed in various directions by seams and fissures, which are frequently filled with the same albertite-like mineral. Resting upon these metamorphosed beds occur slates, shales and sandstones, which contain fossil fishes and a considerable abundance of obscure vegetable remains. It seems evident that these organic bodies furnished by their

decomposition the carbonaceous material in the associated rocks. The heat derived from the slowly cooling injected rocks may have played an important part in this process.

The mineral whose geological occurrence we have thus described, gives, when subjected to chemical tests, almost precisely the same reactions as albertite. It is insoluble in heated acids and alkalies, and is but sparingly if at all soluble in alcohol, ether or oil of turpentine. Like albertite, also, it is infusible, but softens by heat and burns with a yellow flame, emitting an agreeable odor. It gives when incinerated a little less than 0.10 per cent. of ash.—*Amer. Jour. Sci. and Arts, August.*

THE HUDSON RIVER GROUP AT POUGHKEEPSIE.—As the result of the examination of the Hudson River region by Profs. Logan and Hall, these gentlemen traced the "Hudson River Group" as far as Rhineback, and gave that as its eastern boundary. At a June meeting of the Poughkeepsie Society of Natural Science, Prof. T. Nelson Dale (who has temporarily occupied the chair of geology at Vassar College) reported the occurrence of fossils *in situ* in the college grounds. The specimens shown and presented by him to the society were *Leptæna sericea*, an *Orthis* (undetermined) and some fragments of Encrinites. A few days ago Prof. Dale and the secretary of the Poughkeepsie Society of Natural Science, Dr. E. H. Parker, made a careful examination of the rocks on the west side of the river, opposite Poughkeepsie, and about a mile back, and were fortunate enough to discover large quantities of the same species of Brachiopods as those mentioned above, as well as some excellent specimens of what appear to be Fucoids, and similar to what Dana figures as *Buthotrephis*. This discovery would seem to show that the "Hudson River Group" extends perhaps as far as the Highlands.—*W. R. Gerard.*

GEOGRAPHY AND TRAVELS.[1]

AMERICAN GEOGRAPHICAL SOCIETY. PRESIDENT'S ANNUAL ADDRESS.—At the meeting of this Society held in New York, February 11, 1879, the President, Chief Justice Daly, delivered his annual address in which, instead of giving the usual summary of the progress of geographical exploration and research during the past year, he chose as his subject, "The History of Cartography, or the Progress of the Art of Map-making from the Earliest Times to those of Mercator." Cartographic Art, he stated, is probably as old or older than the invention of the alphabet, and has been found in use among races who had had no previous contact with civilized man nor any written language. The Esquimaux understood the charts of Parry and Ross and even extended lines of coast unknown to the explorers. The North American Indians have always had maps which were serviceable to them.

[1] Edited by ELLIS H. YARNALL, Philadelphia.

The earliest thing known in the nature of a map is the ground plan of a town identified as that of Susa, the Shushan of the Bible, a city of remote antiquity. The plan is supposed to be as old as the seventh century before Christ and represents with minute accuracy the details of the town. The Egyptians doubtless had maps and some general idea of the form of the earth. It is from the Greeks that we get our earliest knowledge of maps. Strabo says that Anaximander (B. C. 612) was the first who represented the world on a map. Parmenides, a contemporary of Herodotus, is said by Diogenes Laertius to have been the first person who asserted that the earth was of a spherical form and the same idea was entertained by Socrates. Strabo credits Parmenides also with having been the first to divide the globe into five zones, or, as they were then called, climates. Aristotle, half a century afterward, was convinced that the earth was a globe, drawing that conclusion from the shadow which it casts on the sun in eclipses. Crates (B. C. 325) constructed a globe of the inhabited part of the earth—from the arctic to the tropic in the form of a half circle. Dicearchus (B. C. 296) constructed a map of the world in oval form. With Eratosthenes (220 B. C.) the science of geography may be said to have begun. He devised what has ever since been employed as the most accurate means of determining the circumference of the earth, the measurement of an arc of the meridian. Hipparchus, a century later, first divided the globe by lines of longitude and latitude into degrees. Ptolemy of Alexandria (A. D. 250) is one of the best known of ancient geographers. His geography is based on the work of his immediate predecessor, Marinus of Tyre. The works of Eratosthenes, Hipparchus and Marinus have perished, and the geographies of Strabo, Pomponius Mela and Ptolemy are the only important works of the ancients that have come down to us. A period of 1200 years elapses from the time of Ptolemy to the inauguration by Prince Henry of Portugal of the spirit of maritime enterprise which led to the circumnavigation of Africa and the discovery of the continent of America. This includes the period of the Dark Ages. The Arabs from the ninth to the thirteenth centuries. however, assiduously cultivated geography. To them we owe the preservation of the works of Ptolemy. They determined the obliquity of the ecliptic and measured two arcs of the meridian. Through their intercourse with China the western world probably learned of the mariner's compass. The Chinese also had maps from a very remote period.

After the journeys of Marco Polo and Cademostra in the fifteenth century, many curious and remarkable maps were executed. On that of Benewitz (1524-48) the name "America" first appears. The last and greatest map is that of Gerard Krehmer, better known to the world by the Latinizing of his name as Mercator (1569). His projection not only gave the world in one view,

but showed the most effectual way for a vessel to sail in a straight line over a curved surface and thereby solved what was before one of the most difficult problems of navigation.

OBITUARY.—Dr. J. G. Kohl died at Bremen, his native city, October 28, 1878. He was born April 28, 1808. He was very widely known as the author of a very large number of geographical works and books of travel. These include accounts of travels in Russia, Poland, Austria, Hungary, Great Britain and Ireland, Denmark, Styria, the Alps, Netherlands, Dalmatia and Montenegro, etc. He came to America in 1854, and spent four years in travel, of which he told in books on Canada and the north-western States and Territories. He also wrote several works and papers on the early history, folklore and maps of America. One of his latest productions, remarkable for its learning and research, was a history of the discovery and voyages made to Magellan Straits[1] He made many friends when in this country, and was a member of several of our historical and scientific societies.

Nicholas de Kanikoff, a Russian Orientalist, died near Paris on November 15, 1878. Born October 24, 1819, he at the age of twenty accompanied Gen. Perovski's unfortunate expedition to Khiva, and afterwards traveled much in Asia, especially in Bokhara, Persia (where he was Russian Consul General) and Afghanistan. He published (1845) Bokhara, its Amir and its People, and (1861) a Memoir on the Southern Part of Central Asia, for which the French Geographical Society gave him its gold medal. These and several other works are the source of much of our information concerning Central Asia.

MICROSCOPY.[2]

NEW MICROSCOPICAL SOCIETIES.—The Microscopical Society of Camden, N. J., was organized November 7, 1878, with eighteen members. Meetings are held on the first Thursday evening of every month, at the residences of members. The following are the officers for 1870: President, Albert P. Brown, Ph. G.; secretary and treasurer, Joseph L. De La Cour; managers, Harry S. Fortiner, C. Henry Kain, Samuel S. Cochran; curator, Alfred W. Test.

A Microscopical section of the Cincinnati Natural History Society has been recently formed, with fifteen or twenty members. Meetings are held on the first Friday evening of each month, at the rooms of the Society, with good attendance and the promise of interesting and valuable work.

The Rochester Microscopical Society was organized January 27, 1879, with a membership of nearly forty persons. From

[1] Geschichte der Entdeckungsreisen und Schiffahrten zur Magellan'sstrasse und zu den ihr benachbarten Ländern und Meeren. Von J. G. Kohl. Zeitschrift der Gesellschaft für Erdkunde zu Berlin, 1876. XI band, pp. 315 and 405.

[2] This department is edited by Dr. R. H. Ward, Troy, N. Y.

the number of prominent microscopists in that vicinity, an active and successful society may be looked for. The first officers are as follows: President, Prof. S. A. Lattimore; vice-president, C. C. Merriman; secretary, Dr. E. Line; treasurer, Dr. C. E. Rider.

AMERICAN QUARTERLY MICROSCOPICAL JOURNAL.—This new journal is published by Hitchcock and Wall, at No. 150 Nassau street, New York. The second number, just published, fully justifies the promise of the first, and establishes the Journal as a carefully edited and liberally published work, characterized by an abundance of elaborate memoirs upon microscopical subjects. Illustrations of a high grade are introduced when required. An able summary is also given of recent news and publications; though it may be doubted whether the news as such, can be given in a quarterly with sufficient promptness to meet all the requirements of modern science. It only remains for those who use the microscope or study its revelations to decide whether they will render the new enterprise permanent by making it self-sustaining. A good subscription list is all that is required in addition to what the proprietors have already accomplished.

SALE OF A MICROSCOPICAL LIBRARY.—The library of the late Jno. E. Gavitt is now being broken up, and catalogues of the books for sale can be obtained from his son, W. E. Gavitt, of Stockbridge, Mass. The library includes many rare and almost inaccessible works, which will be doubly valuable as mementos of one of the earliest American cultivators of Microscopy. Mr. Gavitt also possesses a very fine copper-plate portrait of old Anthony von Leeuwenhoek, which, though not specified in the catalogue, could probably be obtained by any one who would appreciate it at its real value.

SPRING CLIPS.—E. H. Hawley, of 102 Grove street, New Haven, Conn., has recently made spring clips for the use of several distinguished histologists. The clips are very light and neat, being made of light steel wire, and having a leather disk instead of a cork to press on the cover. They can be bought for seventy-five cents per dozen.

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SCIENTIFIC NEWS.

— WE are sorry to learn that the Legislatures of Georgia and North Carolina have suspended the geological surveys of those States. This is much to be regretted, since both regions will amply repay to the people the small amounts heretofore expended on them, if only continued long enough to permit the results to be elaborated and published. These measures are a blow at the educational interests of those States which we had not looked for from so-called "reform" legislatures.

— A recent number of the *Gold Hill* (Nevada) *News*, says: "The artificial lake at the mouth of the Sutro Tunnel swarms with fish from three to four inches in length. They were planted in the lake by some Indians about fifteen months ago. They have increased at a wonderful rate, and there now appear to be millions of them. These fish are likely to find themselves in literally hot water when pumping from the flooded mines has been commenced."

— We have received the fourth, fifth and sixth plates of Leuckart and Nitsche's Zoölogische Wandtafeln; these diagrams illustrating the structure of different types of the animal kingdom. Each diagram is a lithograph, costing in Germany from eighty pfg. to at most two marks. They are thus cheap, and on the whole most excellent, and will prove serviceable in schools and colleges. The present diagrams represent the Crustacea and the anatomy of the living crinoid *Rhizocrinus*. This is a most valuable diagram, and very cheap. The sixth represents the metamorphosis of the potato beetle, *Doryphora* 10-*lineata*, and is not particularly well done. One of the figures is not accurate, nor is the beetle sufficiently typical of the Coleoptera, to be selected as a subject for a diagram. They are published by Theodor Fischer, but can be imported, we suppose, through B. Westermann & Co., 524 Broadway, N. Y., or any other importers of German books.

— In the course of a couple hours' search last August, by Prof. A. S. Packard, Jr., and Mr. L. A. Lee, at the Fossil Fish Cut, Green river, Wyoming, the results of which were sent to Mr. S. H. Scudder for identification and description; nearly fifty new species of insects were discovered, showing that these beds are much richer in fossil insects than formerly supposed; nearly all the orders are represented; among them a new dragon-fly, several grasshoppers, eight new Hymenoptera, two new Heteropterous Hemiptera, and eighteen Homopterous Hemiptera, nearly all new and determinable, fifteen new species of Coleoptera, and twenty new species of Diptera. Mr. Scudder is engaged upon a general work on the Tertiary insects of the West, to be richly illustrated. It will form one of the quarto reports of Hayden's U. S. Geological Survey of the Territories.

— M. Lucien Lethierry, Lille, France, desires exchanges of Coleoptera, Hemiptera and Hymenoptera of the United States, for European species.

— Mr. Richard Rathbun is now publishing in the Proceedings of the Boston Society of Natural History, a paper on the Devonian Brachiopoda of the province of Para, Brazil. This constitutes a complete list of the Devonian Brachiopods at present known from the lower Amazonian valley, with descriptions of several new species.

— A paper was recently read by Mr. B. B. Redding before the

California Academy of Sciences, on the desirability of the introduction and culture of the olive in California. From the evidence presented it would seem that in the olive we have a tree that can be grown on the dry plains and naked hillsides of California. In the Eastern hemisphere its limits of profitable cultivation are as far north as the South of France, and as far south as Cairo, in Egypt. Wherever on the coast from San Diego to Monterey, and wherever in the interior of the State, within the limits of the temperature stated, there is an annual fall of rain sufficient to produce barley or wheat—on rocky hills and sandy plains, when once-rooted, this tree will thrive and bear.

— A Wilmington, California, paper, reports among the novelties of that neighborhood, a lake on Dominguez's ranch containing a great number of trout; the lake was stocked by an overflow of the San Gabriel river last winter; some of these fish have reached a foot in length. The settlers in the vicinity are revelling in this acquisition to the ordinary bill of fare.

— Mr. A. H. Curtiss, Jacksonville, Fla., has issued a second fascicle of 250 species and varieties of Floridan plants. Of most of the species enumerated he has specimens outside of his regular sets, as also of most northern plants, and if persons desiring a selection from them will make out a list of their desiderata (the numbers in Mann's Catalogue may be used) he will supply as many of them as possible at $10 per hundred. The fascicles will be forwarded from Cambridge upon receipt of the price, $20. The postage on packages or freight to New York or Boston will be paid by Mr. Curtiss.

— The unusually cold winter in California is indicated by the movements of the wild animals, which have been driven from their usual haunts in the mountains to the lower lands in the immediate neighborhood of the settlements.

The mountain lions, so-called (*Felis concolor*), are reported as very bold in San Gorgonio and San Jacinto, San Bernardino county, since the recent storms; in one instance intruding into the town of Banning in the night. In Carpenteria, Santa Barbara county, these animals made a descent upon a goat ranch and carried off sixteen Angora goats out of twenty-two; quite a loss to the rancher, as the Angoras are valuable stock. Deer are plentiful in the vicinity of Vallecito, Calaveras county, the storms having driven them from their higher retreats. It was recently reported in the local paper, that a party of Indians killed nine deer in one day's hunt. The farmers in and about Lower Lake in Lake county, also complain of the depredations of the "gray eagles" on their young lambs. In other parts of the State the grizzlies are prowling uncomfortably close to the settlements.—*R. E. C. S.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Geographical Society, Jan. 14th.—Major A. G. Constable lectured upon Afghanistan, the present seat of war, and the relations of that country to England and Russia.

Feb. 11.—Chief-Justice Daly delivered his annual address, the subject being Cartography, the history of map-making previous to the time of Mercator.

Boston Society of Natural History, Dec. 18. — Dr. H. Hagen made a communication on the carpet-beetle and other house and museum pests.

Jan. 1, 1879. — Mr. L. S. Burbank remarked on a definite chronological record in certain stratified rocks; also on veins and enclosures in the granite of Rollstone Hill, Fitchburg, Mass., and exhibited crystals and cut gems of yellow beryl from Fitchburg.

Jan. 15—Prof. R. H. Richards remarked on some optical phenomena seen at Lake Superior. Prof. N. S. Shaler spoke concerning the Brighton Amygdaloids.

Feb. 5.—Dr. S. Kneeland read a paper on the monstrous in art, or the relations of zoölogy to symbolism. Mr. W. O. Crosby remarked on the fossiliferous boulders of Cape Cod. Dr. T. Sterry Hunt referred to recent studies in Pre-Cambrian geology.

Appalachian Mountain Club, Jan. 8.—At the election of officers for 1879, Prof. Charles E. Fay was elected president. Mr. Frederick A. Ober read a paper on his explorations in the Lesser Antilles (illustrated by stereopticon views).

Feb. 12.—Mr. J. Raynor Edmands read a paper on the identification of distant points, with a description of Prof. Fernald's recent determination of the position of Mt. Katahdin, Me.

Proceedings of the Academy of Natural Sciences of Philadelphia, December 17, 1878.—President, Ruschenberger, in the chair; Mr. Meehan made some remarks on the seeding of Catalpa, stating that terminal flowers only perfect seed. Mr. Ford from a perfect specimen of *Nautilus pompilius* suggested that the use of the siphon was to keep alive that part of the shell constituting the chambers. Mr. Ryder offered some observations on variations in the number of toes of young *Amphiumæ*, suggesting that the two hitherto recognized genera were hardly yet differentiated from each other.

December 31.—Dr. Ruschenberger in the chair. Dr. Koenig gave the results of an analysis of a new mineral substance which he proposed to call *Kandite*, provisionally. In the election for officers to serve for the ensuing year, which occurred at this meeting, no changes were made from those who served during the preceding anuual term.

January 7, 1879.—Dr. Ruschenberger in the chair. The President announced the death of the Rev. Dr. E. R. Beadle, January

6th, aged 66 years. Messrs. Redfield, Rogers, and Leidy were appointed a committee to draft resolutions expressive of the Academy's esteem for Dr. Beadle. The annual reports of the Sections were then read and referred to the publication committee.

January 14.—Dr. Ruschenberger in the chair. Mr. Redfield for the committee, offered a resolution regarding the death of Dr. Beadle, which was unanimously adopted.

Mr. H. A. Kelly exhibited some handsome and perfect casts of batrachians taken from the animals themselves in gelatine molds. Mr. Ryder said he had recently observed that the jaws of herbivora were moved from without inwards, instead of the reverse, which threw new light upon the subject of the "mechanical genesis of tooth-forms." Dr. Leidy exhibited some lemons with a species of coccus or scale insect adhering to the rind, which he thought might become a serious pest in Florida, from whence the specimens were obtained. A letter accompanied with blanks, from Charles F. Folsom, was read by the President, requesting the coöperation of the members of the Society, in the collection of statistics relating to the subject of heredity.

December 16th, 1878.—Biological and Microscopical Section, Dr. R. S. Kenderdine in the chair. Professor J. Gibbons Hunt delivered a very interesting lecture on the lichens. His remarks were beautifully illustrated by many fine specimens of his own preparation, demonstrating the minute structure of these simple plants, which are found everywhere encrusting rocks, stones, the bark of trees, etc. A dish in which a large number of specimens were tastefully arranged by Professor Hunt under a bell-glass attracted much attention, forming as it did a display quite equal in beauty to the handsomest fernery. Speaking of their habitat, the speaker said that these, as well as many other interesting plants, were found in the greatest profusion and variety in the swamps of New Jersey, which he called the paradise of the botanist. After going briefly over the classification of these plants, the lecturer entered upon their anatomy. The great interest and value of the study of these plants as a means of mental discipline, and their use in the arts of design, were also dwelt upon by the speaker. Mr. Lewis exhibited a specimen of a rare wheel animalcule of marvelous beauty belonging to the genus *Stephanoceras* from the vicinity of Philadelphia.

Jan. 6.—Biological and Microscopical Section, Dr. R. S. Kenderdine in the chair. Dr. Carl Seiler favored the society with a discussion of the leading facts of animal histology, the branch of science which has for its subject-matter the consideration of the various kinds of cells composing animal bodies. He considered the classification of the living tissues according to their offices. These, he said, could be very simply and conveniently divided into three classes, as follows:—1st, connective; 2d, epithelial; and 3d, the nervous.

The speaker's remarks were illustrated by numerous beautiful microscopical objects prepared by himself, some of which showed as many as four different colors, each component part of the cells being of a different color, all of which had been accomplished by artificial means, though the process was comparatively a simple one. The great practical use of the study of histology and the comparative ease with which its main principles might be acquired, were dwelt upon, as well as the great facilities which were now offered to students owing to the mechanical and optical perfection of American microscopes, and the excellence of the technical processes devised and discovered by our own students.

Some further remarks were make by Dr. Dixon, Mrs. Professor White and Dr. Hunt, the latter of whom differed with Dr. Seiler in relation to some minor points relating to the origin of the connective tissues.

Mr. J. A. Ryder then offered a résumé of recent researches on the very first stages of cell-division and multiplication as worked out by the younger European biologists, who seem to have left off where the older workers began. These researches, he believed, indicated more decidedly than ever the identity of animal and vegetable protoplasm. In both the animal and vegetable cell the behavior of the central nucleus of the cell seemed to be quite the same; as it elongated preparatory to division, it was seen to be composed of two opposite poles, from which very minute granules were disposed in lines radiating in every direction, whilst curved lines of granules connected the poles. The appearance was that presented by iron filings scattered on a plate of glass, and made to arrange themselves in a curious fashion when the poles of a horseshoe magnet are applied beneath. It was not claimed that the process of cell-division was a magnetic process, but it was simply a resemblance which was suggested between the two phenomena. The curved lines of granules uniting the poles of the cell-nucleus, in the course of time, form nodes or enlargements which mark the point of division equatorially of the cell into two. The radiate arrangement of the granules at the opposite poles of the nucleus has induced Fol to call it an *amphiaster*, meaning like two stars joined together. The formation of the female and male pronucleus in the egg-cell was also considered, and shown to be produced previous to fertilization, at least in the case of a star-fish and a small species of leech. Many further observations were offered in regard to certain recently-discovered phases of embryonic development.

Mr. Lewis exhibited a fine living specimen of wheel-animalcule, the Lymnias.

SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS.—January, 1879. Mesozoic strata of Virginia, by W. M. Fontaine. Notices of fifty species of east-coast fishes, by G. B. Goode and T. H. Bean. Age of the clay slates and grits of Poughkeepsie, by J. N. Dale, Jr. New order of extinct reptiles (Sauranodonta), from the Jurassic of the Rocky Mountains; principal characters of American Jurassic Dinosaurs, by O. C. Marsh. Early Types of Insects, by S. H. Scudder.

February.—Has Lake Winnepeg discharged through the Minnesota within the last two hundred years? By J. E. Todd. The relation of secular rock-disintegration to loess, glacial drift and rock basins, by R. Pumpelly.

PSYCHE.—September–December, 1878. Life history of Danais Archippus, by T. L. Mead. Breeding habits of Callosamia promethea, by C. E. Webster.

January, 1879.—The nervous system of Phylloxera, by E. L. Mark.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—January. On the existence of a head-kidney in the embryo chick, and on certain points in the development of the Müllerian duct, by F. M. Balfour and A. Sedgwick. Notes on some reticularian Rhizopoda of the Challenger expedition, by H. B. Brady. Researches on the Flagellate Infusoria and allied organisms, by O. Bütschli. The morphology and systematic position of the Spongida, by F. M. Balfour. Flagellated organisms in the blood of healthy rats, by T. R. Lewis.

THE GEOLOGICAL MAGAZINE.—December, 1878. On the occurrence of a fossil tree in the Upper Silurian of Ohio, U. S., by E. W. Claypole.

ZOOLOGISCHER ANZEIGER.—December 16. Voges, on the Morphology and anatomy of Julidæ.

CANADIAN NATURALIST.—December 20th, 1878. Graptolites of the Niagara formation, by J. W. Spencer. On some marine invertebrata from the West Coast of North America, by J. F. Whiteaves. Description of a new species of Paragorgia from Jervis Inlet, B. C., by A. E. Verrill.

THE GEOGRAPHICAL MAGAZINE.—December, 1878. The Bolan Pass (Map). Account of the Dutch Arctic Expedition, by one of the seamen. Voyages between Northern Europe and Siberia in 1878. Darien Interoceanic Canal. (This Journal ceases to exist with this number.)

THE

AMERICAN NATURALIST.

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ANIMAL MUSIC, ITS NATURE AND ORIGIN.

BY XENOS CLARK, B.S.

THE songs of birds and the few other animals that sing, have almost exclusively been treated of in the world of sentiment, where poet-naturalists and nature-poets have culled a wealth of fancies that will endure as long as there is human emotion, but which count for little in the field of exact knowledge. They are choice reading; a kind of pleasure gardens. The purpose here is simply to bring together such songs as have been written in musical notation, and from this compilation to make whatever inductions may seem of scientific value to ornithologists, physiologists, psychologists and theoretical musicians, whose studies touch this subject.

The young bird acquires his song by traditional inheritance; that is, each brood, endowed by physiological inheritance with a certain aptitude, learns, after long practice, by constantly hearing the song of its elders, the melody peculiar to that species, which is in turn similarly transmitted to the succeeding generation. In conclusive proof of this is the fact, that a young nestling reared by foster-parents of some other species will learn their song. Hon. Daines Barrington (I),[1] an early and discriminating observer, says, "I have educated nestling linnets under the three best singing larks, the skylark, woodlark and titlark, every one of which, instead of the linnet's song, adhered entirely to that of their respective instructors." This process seems very decisive, for a titlark-linnet (a linnet educated by a titlark), well fixed in song, which he kept for three months with common linnets in full song, borrowed no passages, but adhered to the titlark melody. It

[1] The references are made by Roman numerals to the list at the end of the article.

is evident, therefore, that birds acquire their songs as infants acquire a language, by instruction rather than by instinct; and that those of the same species sing alike for the same reason that children of one nationality speak alike, viz: that their instructors have a common tongue.

The next question is, how birds came originally by the notes which are peculiar to each species. Daines Barrington answers this also, saying substantially that scarcely any two birds of the same species sing exactly alike; there are, so to speak, "provincial dialects" in different districts, as well as individual mannerisms and defects. All these minor differences, continually renewed, will be imitated by the young birds, and passing from them to succeeding generations, will be perpetuated and grow to wider divergencies. The loss of a parent at the critical period, also, will compel the young bird to invent or copy from other birds, perhaps of different species. Had this explanation been thought out a hundred years later, in 1873, it would have been added that of all these variations sexual selection would perpetuate the most agreeable, so that, as Darwin says (II, p. 378), "It is not difficult to imagine the steps by which the notes of a bird, primarily used as a mere call, or for some other purpose, might have been improved into a melodious love song."

The ultimate origin of melody is a more difficult problem. Darwin writes elsewhere (II, p. 569), "But if it be further asked why musical tones in a certain order and rhythm give man and other animals pleasure, we can no more give the reason than for the pleasantness of certain tastes and smells." I will attempt here to briefly answer this question, reserving at present the fuller statement of a theory, which, very strangely, has never before been hit upon, though Darwin in the paragraph preceding that just quoted, and Helmholtz (III, p. 553) have almost come upon it, and then passed by.

A musical sound is compound in its structure, being really a group of simple tones heard simultaneously; in fact, a chord. This group is composed of a ground tone or fundamental, which predominates, and of a number of overtones, that decrease in intensity as they rise in pitch through a series of harmonic intervals. Thus between the ground-tone and over-tone No. 1 is the interval of an octave; between Nos. 1 and 2, of a fifth; between Nos. 2 and 3, of a fourth; between Nos. 3 and 4, of a major third (see songs No. 1). These intervals, the octave, fifth, fourth

and third, which thus occur in every musical sound we hear, and which existed as physical peculiarities of vibrating bodies long before any living being came upon the earth, are also at the basis of human and, I hope to show, extra-human melody. It is a very suggestive coincidence, too thorough-going to have occurred by chance. The thought at once arises that the peculiar, compound, harmonic structure of musical sounds (more accurately, of the vibrations which produce them) has in some way impressed itself upon the auditory mechanism; so that melody, gradually growing under the guidance of the ear thus modified, has been moulded into a musical form similar to that possessed by the group of harmonically-related tones which we have seen to compose the sounds indicated.

This seems very probable. For since each terminal nerve of the thousands in the cochlea responds to a given simple tone, the group of such tones forming a musical sound will excite a corresponding group of nerves, which will of course be related amongst themselves as are the exciting tones amongst themselves; that is, they will be serially octaves, fifths, fourths and thirds apart. Every nerve will, therefore, have always been stimulated in company with certain others, at harmonic intervals from it; and it is inevitable that the incessant and long continued repetition of this coöperate activity should have resulted in some anatomical or functional bond; a pathway, as it were, leading from each member of the group to every other. *The progress of any melody will be easiest along this harmonic pathway, worn by the physical structure of sound.*

For this reason it seems to me, "musical tones in a certain order give man and other animals pleasure."[1] Take the case of some primitive bird of the type from which the various Insessores have diverged (singing birds belong chiefly to this Order). For innumerable years the harmonic structure of sound vibrations had been impressing itself upon the auditory mechanism of his ancestors, segregating the terminal nerves, or whatever the auditory units might be, into groups, and habituating the members of each group to concerted activity. He, in turn inheriting that

[1] The word *pleasure* has been a stumbling block. Were the concretes of which it is the abstract always expressed, thus—"I feel an easy performance of some function; or a general nervous stimulation and exaltation; or an impulse to continue this sensation or action"—were this done, many seeming difficulties of physio-psychology would vanish.

modified mechanism, began to sing, at first a single note. When this grew wearisome and for remedy the pitch was altered, true song arose. But the change of pitch could hardly have been at haphazard; the first note excited a nerve belonging to a certain coherent group, and it was a necessary alternative that the next note should excite some other nerve, either within or without that group. If within, the combination had occurred millions of times; if without, perhaps not once. I cannot doubt that the change was within the group; was harmonic; indeed the overtones of the first note had already slightly stimulated the related nerves, so that their faint tremor extended, as it were, an invitation to touch them more firmly. The invitation was followed, and then other similar ones, and finally the song grew harmonic, because it followed the easy, preëstablished pathway, rising and falling octaves, fifths, fourths and thirds from one to another of the many-grouped nerves. He sang to please himself or his mate, and the most pleasing combination of notes was that most easily heard; the combination producing least friction and securing the most economical action of the sound-receiving apparatus.

In this brief exposition all details are neglected, and even inexactness admitted where rigorous truth of statement would consume too much space. The more technical treatment of the theory, if it can be called that, belongs to physiological acoustics, in which province many facts tend to its support. The further evidence that can be appropriately presented here, consists of certain statistical proofs gathered from the bird songs which occupy the last pages of this article, and it seems very conclusive.

There are four hundred and six intervals in the thirty-eight bird songs. Of these, all below the major third may be considered as a "filling in"—material for runs, trills, etc.; they number one hundred and eighty-four.

The major third and the intervals above it are the true progressive steps followed by the bird's ear in the long leaps of his song; there are of these two hundred and twenty-two. The following table will show the details:

Interval	Maj. 3d.	4th.	Dim. 5th	5th.	Mi. 6th.	6th	Dim. 7th	7th	8th.
No. of tones . .	2	2½	3	3½	4	4½	5	5½	6
Absolute No. . .	58	55	5	60	12	8	4	. . .	20
Proportional No.	26 per ct.	25 per ct.	2 per ct.	27 per ct.	6 per ct.	4 per ct.	1 per ct.	. . . .	9 per ct.

These results are as pregnant as they are simple. The perfect fifths, fourths, thirds and octaves have a marked predominance, their proportion of the whole number being respectively twenty-seven per cent., twenty-five per cent., twenty-six per cent. and nine per cent., or taken all four together, eighty-seven per cent. as against thirteen per cent. of the remaining five intervals. Nearly all the songs illustrate this pronounced harmonic character; that of the song sparrow (Nos. 18–22), for example, in which the best intervals lie between the trills, is very good. Indeed, the very fact that various keys are selected in which to write bird songs is proof that they rest on the same basis as human music. And the immense preponderance of harmonic intervals seems sufficient answer to whatever may be said about the difficulties and possible inaccuracies attendant on the writing of these songs.

There are some curious observations on the singing of birds in concert which seem to show that they have an "ear for music." Daines Barrington (I) says that, as tested by trained ears, a dozen singing birds of different kinds in the same room made no disagreeable dissonance. And Mr. Augustus Fowler writes me that in a meadow where many red-winged black-birds are congregated, one may "hear their familiar notes pitched to the same key; not a discordant note is uttered because the intervals are thirds, fifths, etc." In a concert of male goldfinches, when they sing for an hour together, "although one may pitch his tune and commence singing, the others following, begin their tunes on the same pitch, and to an unpracticed ear, or to a casual observer, their notes seem discordant, when they are in perfect unison."

What few songs of other animals than birds can be gathered, point even more strongly in the same direction. Darwin (II, p. 567), speaking of the *Hylobates agilis*, an ape allied to man, says, "This gibbon has an extremely loud but musical voice. Mr. Waterhouse states (XVI), 'It appeared to me that in ascending and descending the scale, the intervals were always exactly half-tones, and I am sure that the highest note was the exact octave to the lowest. The quality of the notes is very musical; and I do not doubt that a good violinist would be able to give a correct idea of the gibbon's composition, excepting as regards its loudness.' Mr. Waterhouse then gives the notes. Prof. Owen, who is a musician, confirms the foregoing statement. This gibbon is not the only species in the genus which sings, for my son, Francis Darwin, attentively listened in the zoölogical gardens to *H. leu-*

ciscus whilst singing a cadence of three notes, in true musical intervals and with a clear musical tone."

The Rev. S. Lockwood writes in the AMERICAN NATURALIST (VI) of a most interesting singing mouse, *Hesperomys cognatus*, and fortunately gives the music, written by his son (Song No. 39). He says, "Although she had no ear for time, yet she would keep to the key of B (two flats) and strictly in a major key. Her soft clear voice falls an octave with all the precision possible, then at the wind up it rises again into a very quick trill on C sharp and D. When singing whilst turning in her wheel, and suddenly thrown on her back by its stoppage, as if in surprise, she would roll off four or five notes in a higher octave, and in a greatly increased loudness of voice.'

In answer to some inquiries, Mr. Lockwood kindly writes me as follows: "Octaves, fifths and thirds were usually selected for the long intervals of *Hesperomys*' song. I have had and still have singing guinea pigs, *Cavia cobaia*. What is said of my *Hesperomys* is in the main true of the *Cavia*. There are other rodents that sing, *Mus musculus*, or house mouse; the rat, *Mus rattus*; the white-footed mouse, *Hesperomys leucopus*; the woodchuck, *Arctomys monax*, and the squirrels." Recent numbers of *Nature* (VII) and the *Popular Science Monthly* (VIII) contain brief accounts of singing mice. That in the former confirms some curious phenomena observed by Mr. Lockwood—the singing of an air with an accompaniment, and the influence of fright as well as joy in starting the song.

It is doubtful whether true music is produced by any invertebrates. There seems to be no provision in the ear for the exact discrimination of pitch, and the sounds are instrumental rather than vocal, being generally produced by stridulation. Some references, however, are given with the others to what has been written on this subject (XXII to XXVI, see also II, pp. 274, 289, 301).

For assistance in my work of collecting and studying animal songs I am much indebted, especially to Mr. Wilson Flagg, Prof. E. R. Sill, Dr. Elliott Coues, Rev. S. Lockwood, Mr. H. A. Purdie, Mr. Robert Ridgway, Miss Alice Bacon, Mr. H. D. Minot and Dr. P. L. Hatch. It was necessary that the work should be largely one of compilation, for the material had never been brought together before. Thus the attempt has much of a pioneer character, and my chief hope is to direct attention to this *important* field of study, where acute observation is very much

needed; for the comparative sciences hold the keys to all questions of origin, and their method is simply the intelligent noting and collating of the facts of Nature. Allegiance to this method in the field of animal music has even at this early stage resulted in two encouraging starting points for future work—a statistical demonstration of the harmonic character of animal, especially bird, song; and a theory for the origin of melody, whether human or extra-human, which besides the usual basis of physiological acoustics, employs the law of modified, inherited, selected and adapted structure, *i. e.*, the law of evolution.

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VIII. "Singing Mice," by Henry Lee, *Pop. Science Monthly*, Vol. XIV, 1878, p. 102.

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XII. "Music of Nature," by Gardiner. London, 1832.

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XVI. Given in W. C. L. Martin's "General Introduc. to Nat. Hist. of Mamm. Animals," 1841, p. 432; Owen, "Anat. of Vertebrates," Vol. III, p. 600.

XVII. J. E. Harting, "The Birds of Middlesex." London, 1866. Numerous songs.

XVIII. Kennedy. *N. Abhandl. baier. Akad.* (*Phil. Abhandl.*), 1797, p. 109.

XIX. Savart (*Froriep's Notizen u.s.w.*), 1826, pp. 1 and 20.

XX. Brehm and Hausmann, *Naumannia*. 1855, pp. 54, 96, 181.

XXI. *Journ. für Orn.*, 1855, p. 348, 1856, p. 250.

XXII. "The Songs of the Grasshoppers," by S. H. Scudder, AMERICAN NATURALIST, Vol. II, 1868, p. 113.

XXIII. "Stridulating Crustaceans," *Nature*, May, 1878, pp. 53 and 95.

XXIV. Insect Music, Landois' *Das Ausland*, XLIII (1870), pp. 429 and 430.

XXV. Stridulation of Scorpions. See "Annual Rec. of Science" (Baird), 1877, p. 282.

XXVI. Stridulation of Butterflies, See "Annual Rec. of Science" (Baird), 1877, p. 309.

XXVII. *Language et chant des oiseaux*, par M. F. Lescuyer. (Paris, J. B. Baillière et Fils.)

XXVIII. *Il Canto Degli Uccelli*, note di fisiologia e biologia zoologica in rapporte alla scelta sessuale e alla lotta per l'esistenza raccolte du *Luigi Paolucci*, Professori di Storia Naturale nel R. Instituto Tecnico di Ancona. (Milano, 1878, pp. 130.) This is an elaborate and philosophical memoir treating of animal song in many separate aspects. The notes of insects, batrachians, reptiles and birds are given in musical notation, and elaborately discussed. No less than twenty bird songs are thus written on the gamut, and the peculiar melodic quality of sixty-eight more tabulated. We hope to review this important work in a succeeding number of the NATURALIST.

There are so many possible arrangements for these songs that it seems best to group them according to source, all from one writer in succession. No addition is made in any case to the original text; the names, vulgar or scientific, or both, are given without change. No. 1 is the fundamental C with its overtones (III, p. 33).

Gardiner's "Music of Nature" (Nos. 2–4).

2. **Lark**, England.
3. **Nightingale.**
4. **Robin.**

"The Birds of Middlesex" by J. E. Harting (Nos. 5–15).

5. **Blackcap,** *Sylvia atricapilla.*
6. **Willow Warbler,** *Sylvia trachilus.*
7. **Yellow-Hammer,** *Emberiza cibrinella.*
8. **Ring Plover.**
9. **Peewill.**
10. **Oystercatcher.**
11. **Little Ring Plover.**
12. **Whimbrel.**
13. **Curlew.**
14. **Dunlin.**
15. **Swan.**

"Birds and Seasons of New England," by Wilson Flagg (Nos. 16–31).

16[a]. Song Sparrow, Theme.

17[b]. " " Brisk. (The notes marked guttural seem to be performed by a rapid trilling of these notes with their octaves).

18[c]. Song Sparrow, Joyful.

19[d]. " " Plaintive.

20[e]. " " Fervent.

21[f]. " " Subdued and querulous.

22[g]. " " Brilliant.

23. **Peabody Bird,** *Fringilla albicollis*. (This is a corrected song, sent me by Mr. Flagg.)
24. **Vireo—"The Brigadier."**
25. **Wood Sparrow,** *Hirundo bicolor.*
26. **Whippoorwill,** *Caprimulgis vociferus.*
27. **Chewink,** *Fringilla erythrophthalma.*
28. **Chickadee,** *Parus palustris.*
29. **Golden Robin,** *Icterus Baltimore.*
30. **Green Warbler.** *Sylvia virens.*
31. **Quail,** *Perdix Virginiana.*
32. **Skylark** (caged). Sent me by Mr. Flagg.

"My Garden," by Alfred Smee. London, 1872.

33. **Reed Warbler.**
34. **Thrush.**
35. **Blackbird.**

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36. **Baltimore Oriole.** Call and reply. *Harpers' Mag.*, Sept., '76.
37. **Golden Oriole,** *Oriolus galbula* of Australia. *Science Gossip*, April, 1878.
38. **California Meadow Lark,** *Sturnella neglecta.* Three songs kindly given me by a gentleman familiar with music.
39. **Vesper Mouse,** *Hesperomys cognatus.*
40. **Vesper Mouse,** *Hesperomys cognatus.*

The two above songs, 39 the Wheel Song, 40 the Grand Roll, are given by Rev. S. Lockwood, AMERICAN NATURALIST, Vol. V, '71, p. 764.

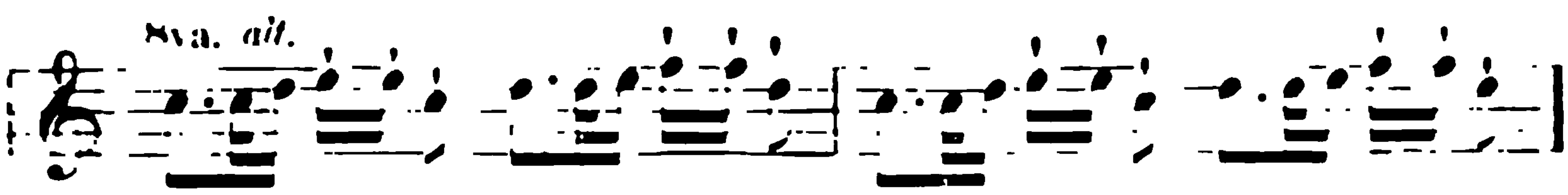
1. OVERTONES OF C.

2. LARK.

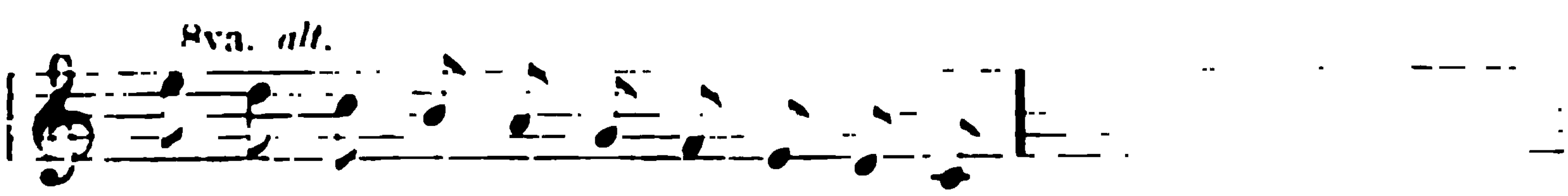
—NOTICE.—

This Music can be had in regular sheet form (ten pages) by sending sixty cents to the publishers.

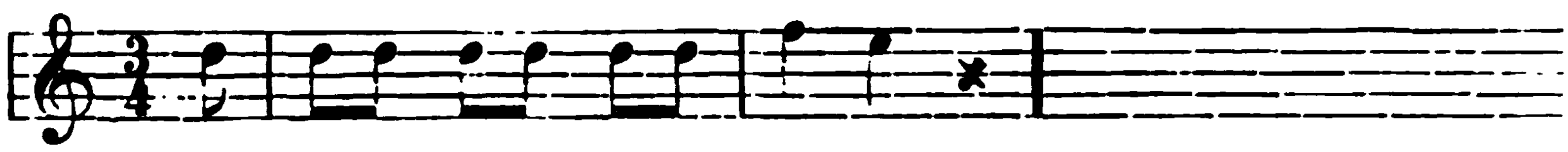
McCALLA & STAVELY,
237-9 Dock St., Phila.



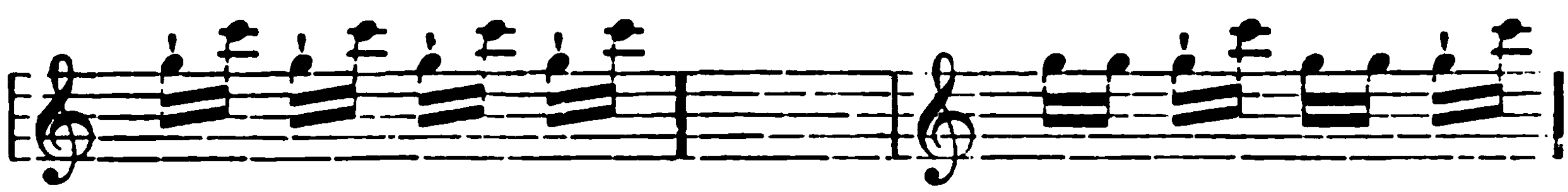
6. WILLOW WARBLER.



7. YELLOW HAMMER.

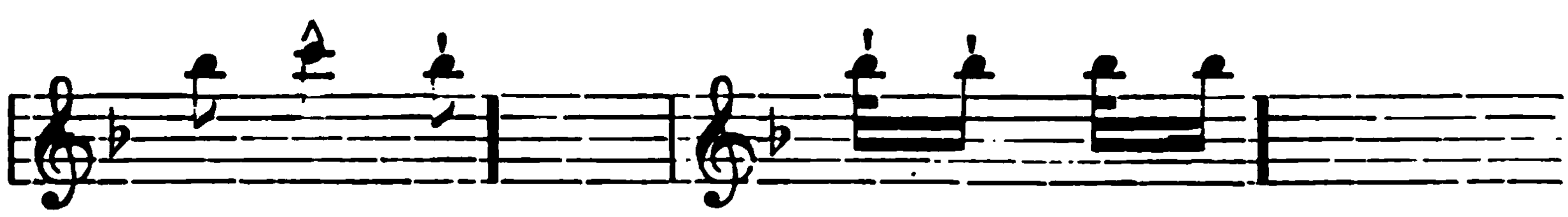


8. RING PLOVER.

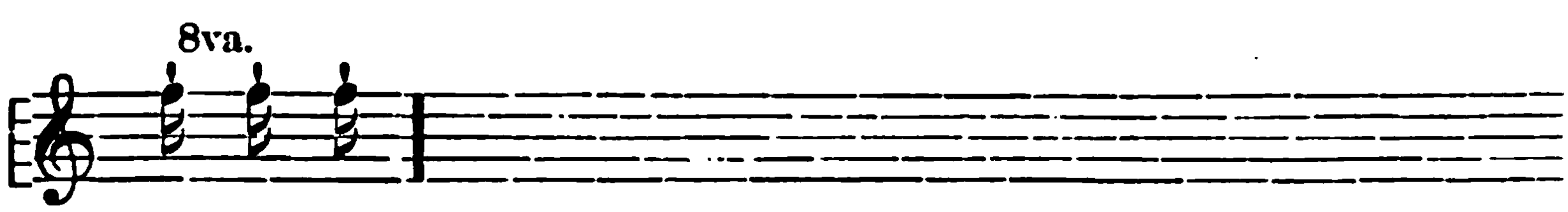


9. PEEWILL.

10. OYSTER-CATCHER.

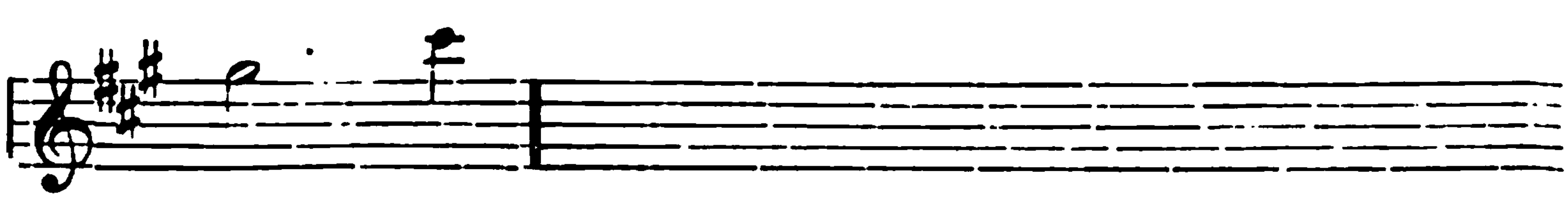


11. LITTLE RING PLOVER.

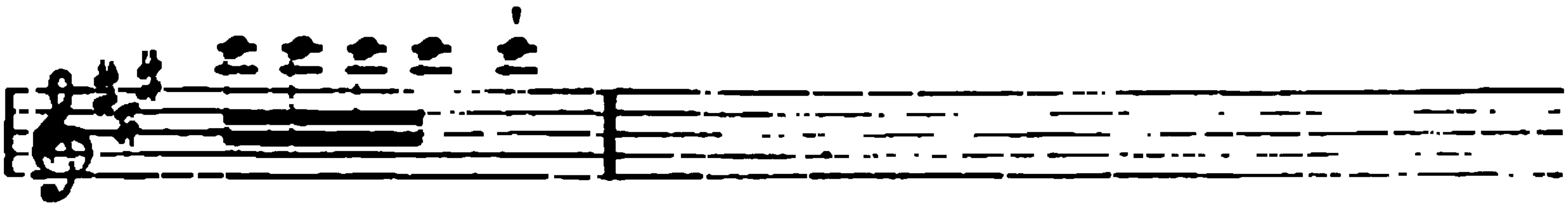


12. WHIMBREL.

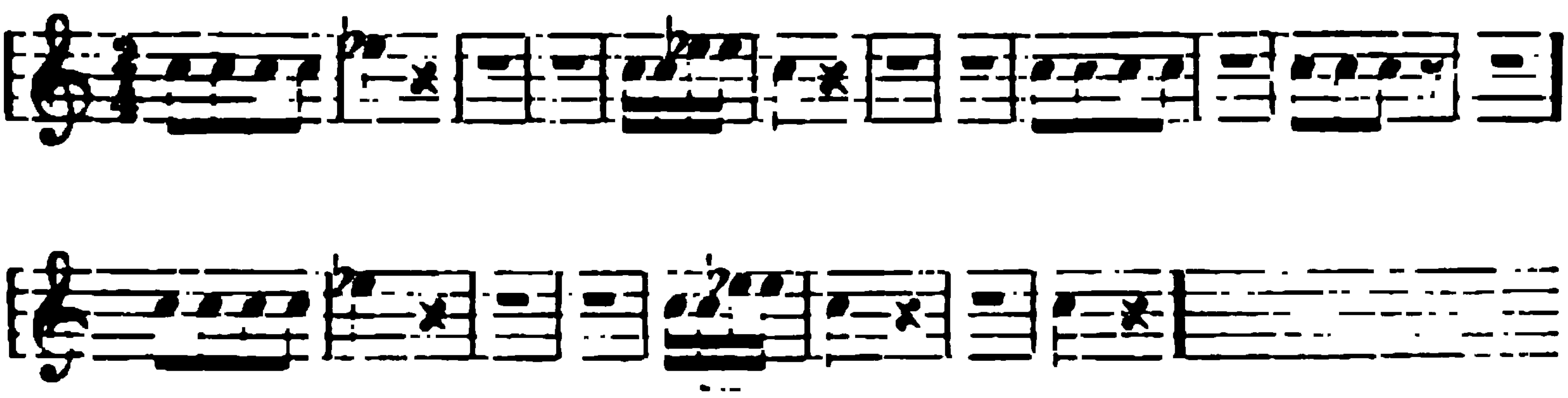
13. CURLEW.



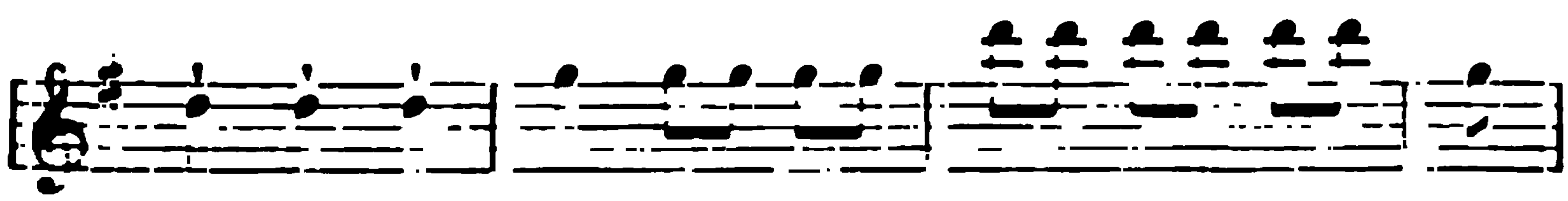
14. DULIN.



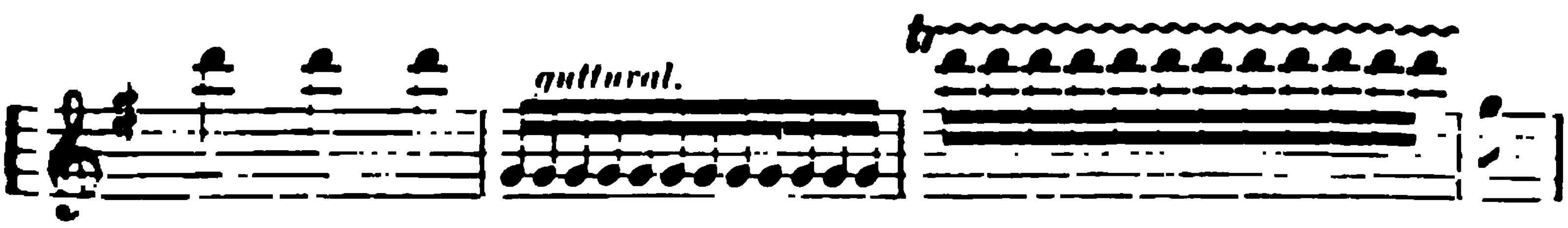
15. SWAN.



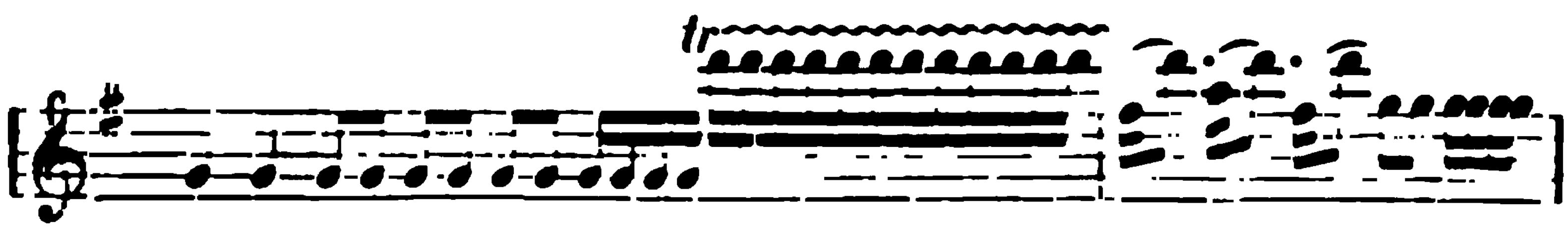
16. *a* SONG SPARROW.



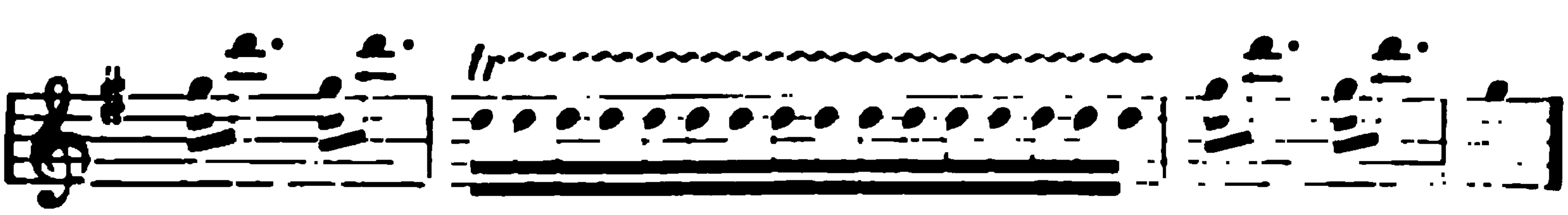
17. *b* SONG SPARROW.



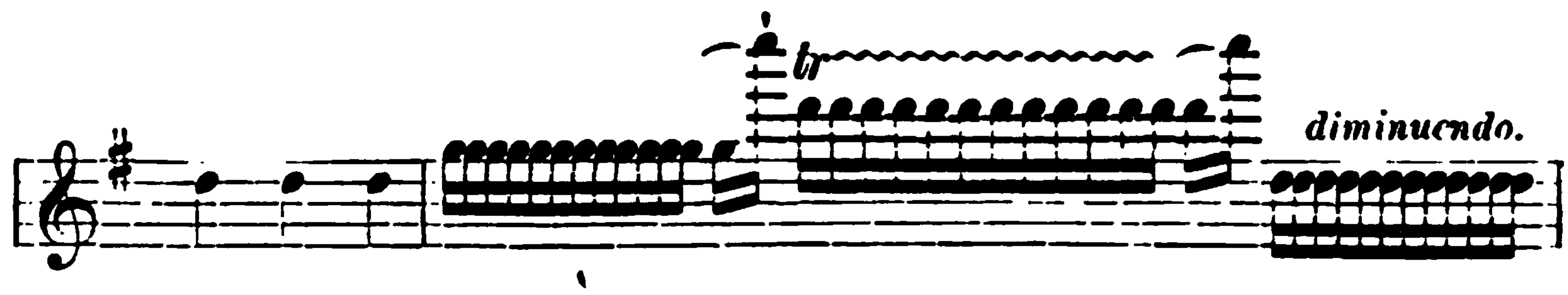
18. *c* SONG SPARROW.



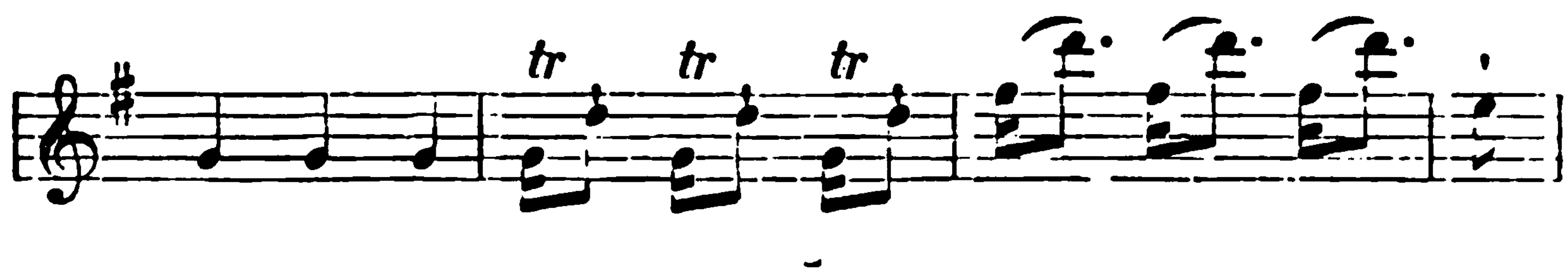
19. *d* SONG SPARROW.



20. *e* SONG SPARROW.



21. *f* SONG SPARROW.



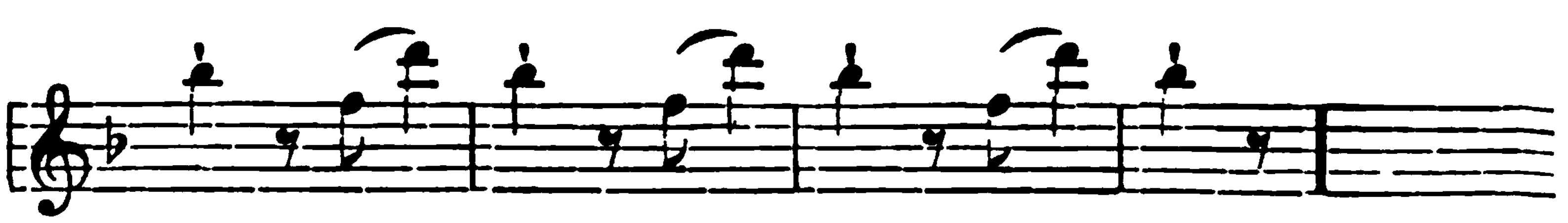
22. *g* SONG SPARROW.

23. PEABODY BIRD.

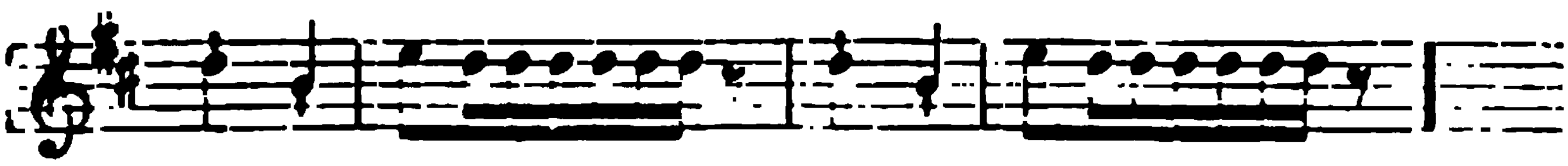
24. VIREO.

25. WOOD SPARROW.

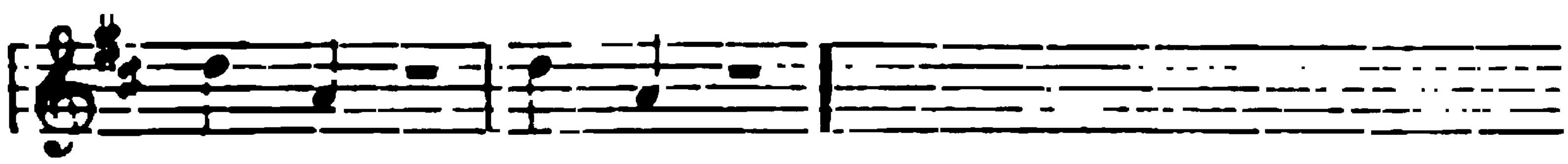
26. WHIPPOORWILL.



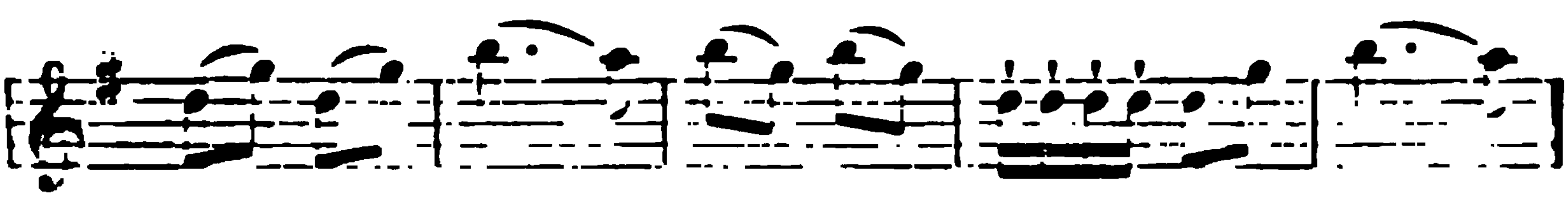
27. CHEWINK.



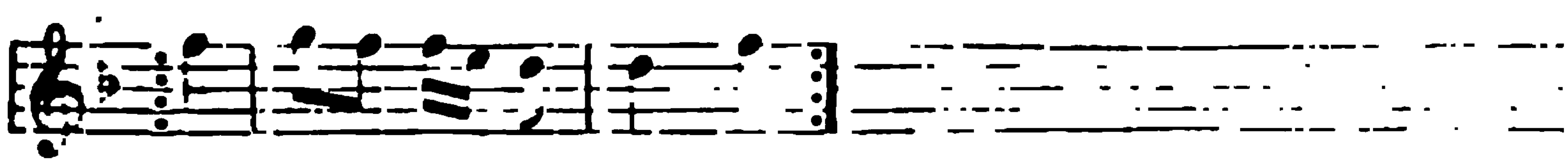
28. CHICKADEE.



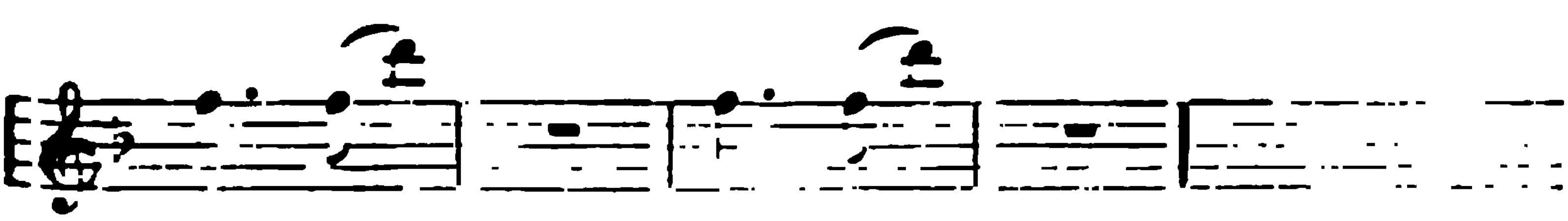
29. GOLDEN ROBIN.



30. GREEN WARBLER.

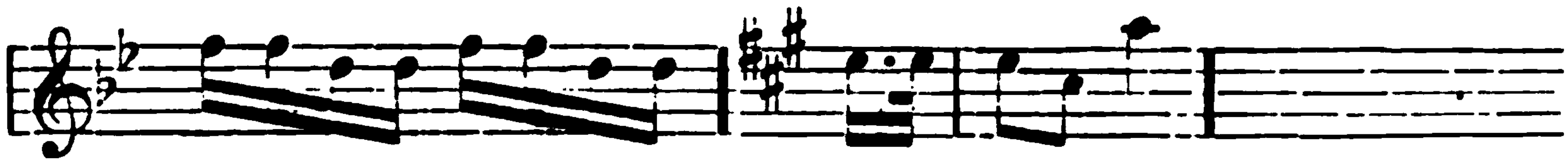


31. QUAIL.

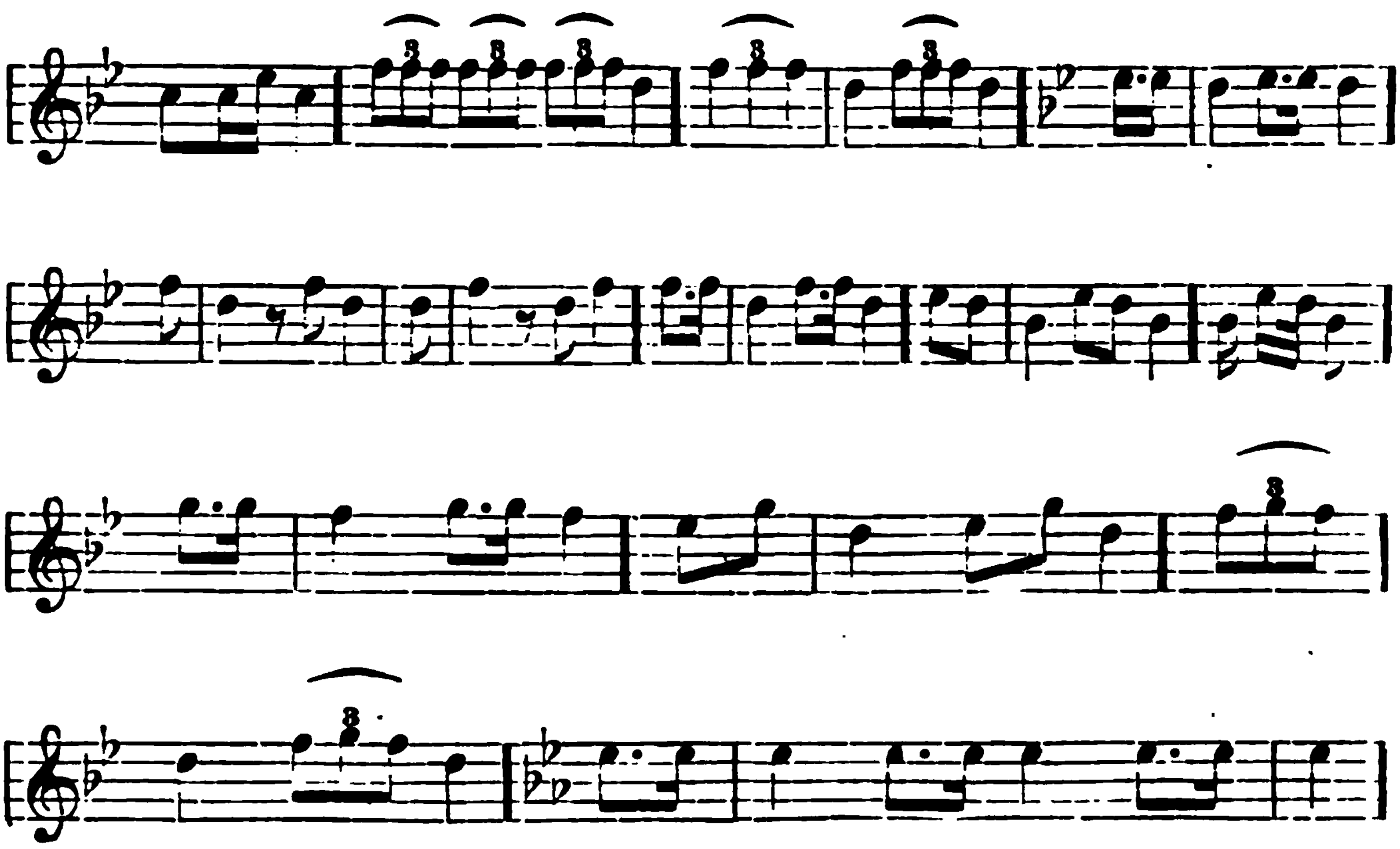


32. SKYLARK.

33. REED WARBLER.

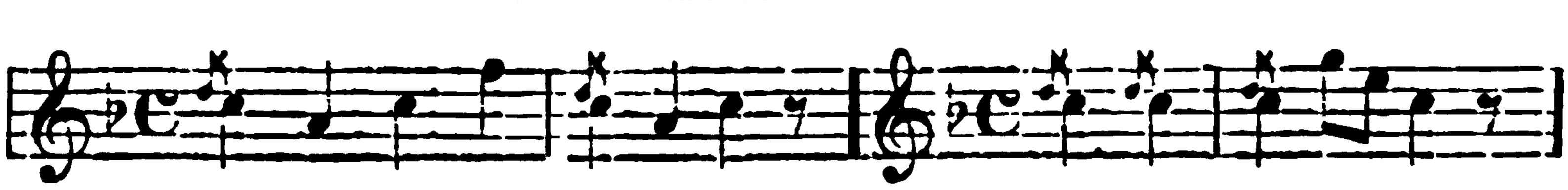


34. THRUSH.



35. BLACKBIRD.

36. BALTIMORE ORIOLE.



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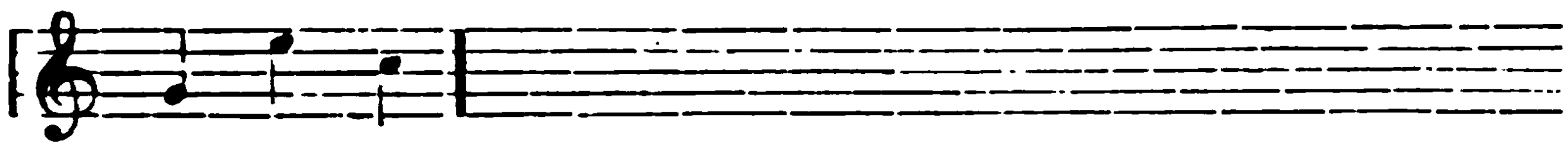
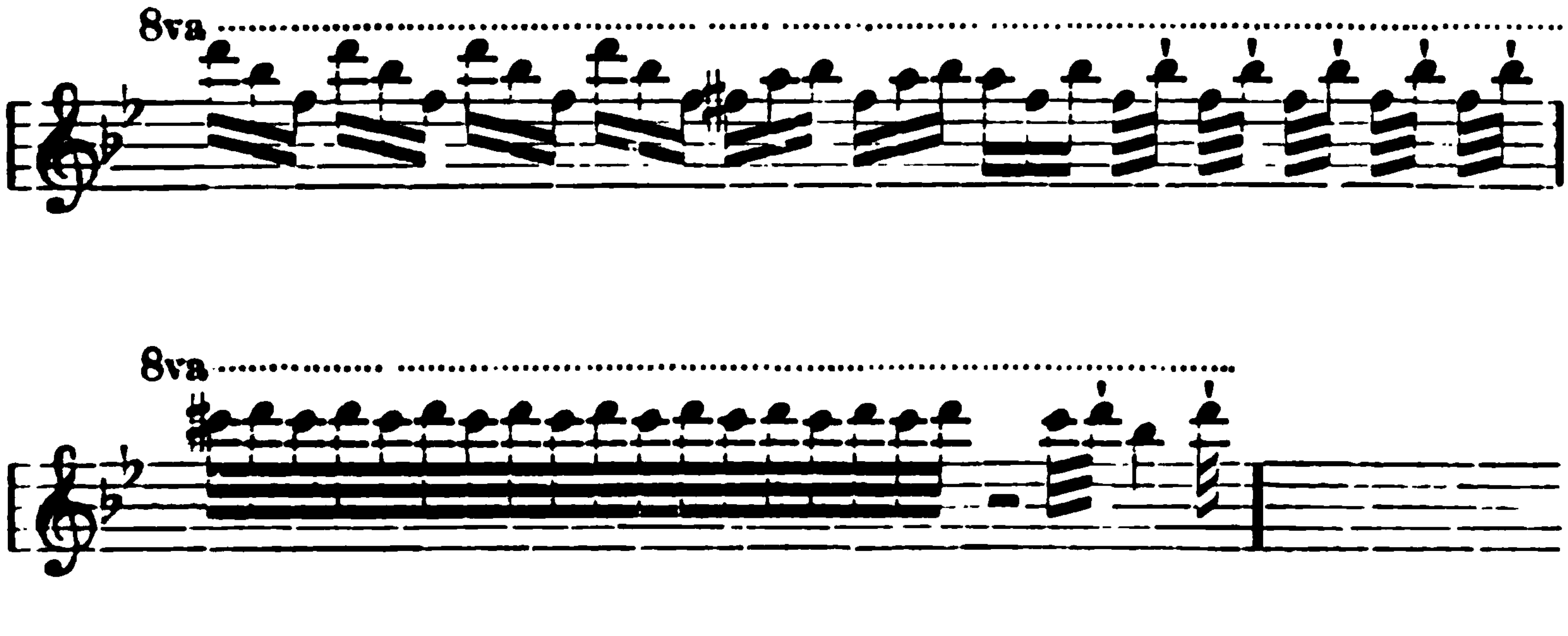
37. GOLDEN ORIOLE.



38. CALIFORNIA MEADOW LARK.

39. VESPER MOUSE.—Wheel Song.



40. VESPER MOUSE.—Grand Roll.

THE ARTIFICIAL MOUNDS OF THE ISLAND OF MARAJÓ, BRAZIL.[1]

BY ORVILLE A. DERBY.

Of all the localities in Brazil where the remains of ancient Indian tribes have been found, the Island of Marajó is the most interesting to the archæologist. Whether the race at this point was a superior one, or whether the conditions under which they lived were more favorable, it is certain that the ancient inhabitants of Marajó, or at least a portion of them, made greater advancement toward civilization than any other of the aboriginal tribes, having excelled in the arts those of every other part of Brazil, so far as we know to-day. In addition to shell-heaps and stone implements, similar to those existing in nearly all the provinces of Brazil, there are found at Marajó antiquities whose characters are quite peculiar to that locality and indicate superiority. I refer to the artificial mounds and the objects they contain, of which I propose to give a brief description.

Marajó, like all the region about the mouth of the Amazonas, is very low, and excepting a small tract in the east, is so slightly elevated above the level of the river, that in the winter it becomes changed into a large lake. Over all its expanse there is not a single natural elevation that might be called a hill, the portions not subject to overflow, being very gentle undulations of the surface, having a height of only a few metres above the surface of the water. As explained by its indefatigable explorer, Dr. S. Ferreira Penna, of Pará, the island may be divided into two nearly equal parts; the western, covered with forests in which abounds the India rubber tree, and the eastern, consisting of plains. It is the eastern part that concerns us now.

The plains being covered with a heavy growth of rich grass, constitute a good grazing ground, and are thus well suited to the raising of cattle, which is to-day almost their only industry.

The farmers have, however, to contend with many difficulties, due in part to the structure of the island. Every year many

[1] Several of the Museums of this country possess collections of pottery from Marajó, procured either by the late Professor Hartt, or by others; but up to this time no accurate account of the region whence they were obtained, has been published. The following translation of a short article, descriptive of this interesting island, which appeared in the Vulgarisador of Rio de Janeiro, September 22d, 1877, may thus prove acceptable to American archæologists.—RICHARD RATHBUN.

cattle are drowned in the lowlands, or fall victims to the alligators, and, from time to time, a more severe winter than usual deprives them of fodder, and occasions severe losses. Another and more important inconvenience arises from the impossibility of retaining in good condition a sufficient number of horses for farm work. Formerly horses thrived so well on the island that they came to take entire possession of the grazing grounds, forming a serious impediment to the industry of cattle-raising, and about forty years ago the farmers killed them by thousands for the sake of their hides. To-day horses are so expensive and their preservation so difficult that they are only in use where it is absolutely impossible to dispense with them. For ordinary service, and even for traveling, oxen are used, and, upon one occasion, I witnessed a troop of horses being driven to their enclosure by herdsmen mounted on oxen.

Near the centre of the island, in the midst of the plains, is a lake called Arary, out of which flows a river bearing the same name. Other important rivers are, the Igarapé-grande, which empties at the south-east part of the island, and the Anajás, which rises a little to the west of lake Arary, and, crossing the forests of the western side, receives, before leaving the plains, the tributaries Camutins and Moções. On the margins of all these rivers artificial mounds exist, but only those of lake Arary and the Camutins have been examined. Those which I shall now describe may be taken as types.

The best known mound is situated by the side of lake Arary, and in the winter becomes transformed into an island called the Island of Pacoval. In shape it is nearly oval, having a length of one hundred and fifty metres, a breadth of seventy metres, and a height of five metres above the water of the winter's overflow, which covers all the neighborhood for many miles around.

On one side of the island, exposed to the action of the waves, is a small cliff, in which the structure of the mound is displayed, and where it is seen that even to its base the earth is filled with pottery and ashes, proving the artificial origin of the mound. The waves have excavated very extensively into it, and the beach below is covered with the fragments of pottery. The mound being thickly wooded, the objects lying near the surface have been much broken up by the roots of the trees, but at a greater depth they are preserved in perfect condition. Several other lo-

calities on the shores of the lake have yielded a similar kind of pottery, but these places have not been investigated.

About six or seven leagues to the west of Arary, on the banks of the Camutins, there exists another well-known group of mounds, and a league farther are over fifteen others of large and small size. The plain is here also very low and subject to inundations, the greatest natural elevations not rising more than one or two metres above the water during the rainy season. A narrow strip of forest usually borders the margin of the river where the mounds, also wooded, are generally encountered; there are, however, other mounds situated upon the plain. The principal mound of the Camutins, known by the same name, is a veritable hill, having a height of fifteen metres above the plain, and with its sides so steeply inclined as to render their ascent on horse-back quite difficult. The outline of the mound is elliptical, its length being two hundred and ten metres, and its breadth at the base about eighty metres; but at the summit it is much narrower. The sides are furrowed by the rain which commences to excavate in holes made for the purpose of procuring *iguacabas*, which are in great demand as receptacles for farinha. In these furrows the earth is seen to be full of pottery and ashes as at Pacoval. As a stronger evidence of the artificial origin of the mound there is found near it a large excavation, similar to those sometimes formed in railroad grading, and from which, without doubt was obtained the material for constructing the mounds. This excavation is on the opposite side of the river, and near it is another mound almost equal in size to that of Camutins. A few hundred metres below the mound of Camutins, on the same side of the river, is a third mound of less height, but broader and probably longer. This last is situated in a bend of the river, being surrounded by water on three sides.

These three mounds all extend in different directions, indicating that their position is without significance. They all have a more or less elliptical or oval form, but this seems to have been accidental, as there is no evidence that they were constructed according to any definite plan. It is quite different with the North American mounds, which in other respects closely resemble those of Brazil. In the former country they often assume the outline of a geometrical figure or of some animal.

According to the statements of the inhabitants there are in the

upper part of the river ten or twelve mounds of smaller size than the above. Still others exist on the margins of the Anajús, Moções and Igarapé-grande, and also in various parts of the plains, distant from any river.

From what has been said it is evident that the mounds of Marajó were the work of man, and that too of an exceedingly industrious race. For what purpose were they built—for defense, as dwelling places, or as cemeteries for the dead? They were probably intended for all these. They were primarily localities for living upon, elevated as much to escape inundation as to afford a better means of defense against enemies. That they were also used for interment is proved by the number of burial urns with skeletons which they contain. The remains of fire and of an abundance of pottery for domestic use indicate as well that they were places of habitation. It is likely that they were the sites of fortified villages, occupied by a tribe holding to the custom, so common among Brazilian Indians, of burying the dead inside the house.

I will now pass to a consideration of the objects found in the mounds; these consist of stone implements and pottery. The former are not common and do not differ notably in shape from those of other localities; they are well polished and made of diorite, a kind of stone which is not found on Marajó, nor at any near locality on the main-land.

Pottery exists in the greatest abundance, and is as noteworthy for its superior make as for the beauty and perfection of form and ornamentation which it displays. Of the majority of objects made by prehistoric man, it may be said that they are curious and interesting, but devoid of taste; that is, they do not gratify our tastes, perfected and purified by centuries of culture and art. Among the vases of Marajó, however, are some that compare very favorably with those of the ancient Greeks and Etruscans in symmetry and elegance of form, as well as in the relief and high grade of their decorations. The ancient inhabitants of Marajó were truly masters in ceramic art.

Considering that the aboriginal mode of making an earthenware pot was to coil up a long strip of clay—and of this fact we have ample proof in the mounds we are describing—it is wonderful to behold a pot thus constructed, measuring almost a metre in diameter, made perfectly symmetrical. This, together with the regularity and perfection of the lines of ornament,

demonstrates the great experience and culture of the maker. The ornaments encountered are naturally divided into three classes—those in relief, the engraved and the painted. The first kind is found upon idols and trinkets, and upon the sides of vessels, often forming handles by which they can be lifted. They are made by the hand, of soft clay, and generally rudely represent the human figure or that of some animal.

The engraved and painted ornaments, however, very seldom represent natural objects, and when they do, it is in a very conventional way, rendering it difficult to interpret them. They are usually of a purely æsthetic character, and include the fret, the cross and other styles very well known in art.

From some of the primitive forms has been worked out an exceedingly interesting series of modifications, from which arises the greatest value of the antiquities of Marajó. It is evident that we have there vestiges of a savage race that had entered upon the first rudiments of art, and advanced so little that it is possible now from their relics to trace each step in the early development of art. As the study of embryology has solved many difficult questions in zoölogy, so has the study of art here in the embryo explained important points in the general history of art.

Prof. Hartt has thoroughly investigated this subject, and has arrived at very important conclusions regarding it. A single example will serve to explain the importance of this study. Ruskin and others have proved that many of the complex designs of architecture and the other arts are evolved from the fret, but no one has carried the analysis farther. Now the pottery of Marajó comes in to complete the series, by showing that this fret originated from straight lines, which the savage, like a child, uses in his first attempts at ornamenting.

I am unable within the limits of this paper to discuss this exceedingly interesting subject further. It simply remains for me to add a few words respecting the uses of these various objects, that an idea may be obtained of the customs and the mode of thought of this ancient people. Some of the objects were doubtless idols, and indicate a form of religious belief to have existed among them; others seem to be trinkets or objects made as pastimes; others ornaments for the dress or person; while others still were articles of domestic use, and even these last were carefully ornamented. Finally, the largest and most elaborate of all were burial urns, sometimes of broad dimensions,

but always so constricted at the mouth as to admit only disjointed bones, deprived of their flesh. In these are encountered human remains, unfortunately, however, so reduced to powder that it is impossible to determine the physical characters of the race.

In conclusion, I can safely affirm, that even to-day it is very hard to find on the Amazonas proofs of greater industry than that furnished by these mounds, or a higher appreciation of the beautiful than is manifested by the ornamentation of the pottery of the ancient inhabitants of Marajó.

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NATIVE BITUMENS AND THE PITCH LAKE OF TRINIDAD.

BY W. O. CROSBY.

MINERAL pitch and the most of the native bitumens have been known from very early times. Among the ancient writers we find many statements indicating not only a knowledge but a practical use of these substances; and it is known that asphaltum was applied to architectural purposes more than four thousand years ago. That this substance was held in high estimation may be inferred from its being ranked by these writers among the best building materials of those ages, and from its application to structures requiring great solidity and permanence.

It is mentioned at several places in the Bible under the names of *slime* and *pitch*: Noah, in building the ark, being commanded to "pitch it within and without with pitch," while we read that the bulrush ark of the infant Moses was "daubed with slime and with pitch." Herodotus says it was used as a cement in building the strong walls of Babylon, large quantities being brought down to the Euphrates by the small river Is. These fountains of Is, celebrated as having attracted the attention of Alexander the Great, Trojan and Julian, still continue to pour out inexhaustible supplies. The same author describes the mode of obtaining solid bitumen and petroleum from a spring near Anderica, on one of the Ionian islands, and of separating them from each other and from foreign substances. This spring is flowing there to-day.

Diodorus Siculus and Josephus noticed the bitumen of the Dead sea, its use in medicine and in coating ships; its importation into Egypt; and its being there used with aromatic spices for the purpose of embalming bodies, which it preserved from putrefaction.

In their structures, the Romans directed much attention to solidity and permanence, and of course endeavored to select what were considered the most useful and durable materials. That these materials were often good is shown by the state of preservation of many of their works, and by the fact that their cement is scarcely equaled by any of modern time; and yet Vitruvius, a celebrated architect of the age of Augustus, speaks of bitumen as superior to every other kind of cement, and regrets its scarcity.

Notwithstanding the long time that native bitumens have been known, it is only within the present century that they have come to be extensively employed in the arts; and that geologists and chemists have reached definite conclusions concerning their origin, modes of occurrence, properties and relations. The prevalent notion that these substances are of rare and limited occurrence is entirely erroneous, for, as I shall presently show, the bitumens, taken as a class, are very widely and abundantly diffused through the crust of the earth. They are found in every quarter of the globe, and in every geological formation from the Cambrian to the present time. Their occasional association with what appear to be igneous rocks, has led some writers to infer that in their origin they are in some way connected with volcanic action. An explanation which, as Canon Kingsley has remarked, "savors somewhat of a 'bull;' for what a volcano could do to pitch, save to burn it up into coke and gases, it is difficult to see." When, as undoubtedly sometimes happens, the bore of a volcano passes through sedimentary strata holding bitumen or bituminous coal, it is easy to see how the connection of these substances with volcanic products may arise. But be their associations what they may, it has been definitely settled that in their origin the bitumens, like the coals, are always strictly organic. In every case they are the more or less transformed tissues of plants or animals.

Under the general name of bitumen are included both the liquid forms, petroleum and naphtha, and the solid varieties such as asphalt. Chemically considered, the bitumens are hydrocarbons the average composition being represented by the general formula $C_n\ H_{2n}$. The so-called bituminous coals, which, however, are destitute of true bitumen, are likewise hydrocarbons. These are distinguished from the bitumens by their smaller *hydrogen ratio*, analysis affording the general formula $C_n\ H_{\frac{2n}{x}}$, and

by the important facts that unlike many of the bitumens they are not liquid at ordinary temperatures, and unlike all the solid bitumens, are incapable of assuming the liquid state on the application of heat. The coals partake in a large degree of the nature of their chief constituent element, carbon, the most thoroughly solid substance known, distinguishing, as we should, solidity from density. In their entire insolubility, again, the coals are strongly contrasted with the bitumens, the latter class being all more or less soluble in liquids like benzole, sulphide of carbon, oil of turpentine and ether; and the less fluid bitumens, as asphalt, dissolving in the more fluid, naphtha-like, varieties.

Notwithstanding the general distinctness of these two great classes of native hydrocarbons, there is a point where they are not easily separated. Among the bitumens there are different degrees of fusibility and solubility, and a concomitant variation of the hydrogen ratio, presenting a regular gradation as we pass from naphtha with the maximum solubility and fusibility, and the largest proportion of hydrogen, through petroleum, mineral tar, and the various asphalts to idrialite, which, having the composition of bituminous coal, is fusible with difficulty, and only slightly soluble. From idrialite the passage is easy to true bituminous coal, and from this, as is well known, to anthracite. So that, as Dr. T. Sterry Hunt has stated it, "Anthracite or nearly pure carbon, on the one hand, and petroleum and naphtha, or carbon with a maximum of hydrogen, on the other, represent the two extremes of a series of which bituminous coals and asphalts are intermediate terms."

Following is a list of the more important members of this series, with their formulas, which have been calculated for twenty-four equivalents of carbon, to compare with the chief constituent of wood, cellulose:

Cellulose		$C_{24}H_{40}O_{20}$
Naphtha, Petroleum		$C_{24}H_{50}$
Mineral Tar		$C_{24}H_{48}$
Asphalt	varies from	$C_{24}H_{44}O$
	to	$C_{24}H_{38}O$
Idrialite		$C_{24}H_{16}$
Bituminous coal	varies from	$C_{24}H_{20}O_{3}$
	to	$C_{24}H_{16}O$
Anthracite	varies from	$C_{24}H_{10}O$
	to	$C_{24}H_{6}O_{.5}$

A little study of these figures will make it clear that all these different hydrocarbons may be produced, theoretically at least, by removing from cellulose, which represents all woody matter, variable proportions of carbonic anhydride (CO_2), marsh gas (CH_4), and water (H_2O); and this is, in many cases, the course that nature pursues. Under ordinary conditions decaying wood is attacked by the oxygen of the air and burned up to carbonic anhydride, water and ashes as completely as if thrown into a furnace; but if kept out of contact with the atmosphere, as when lying beneath the water and mud of a marsh, or buried in deposits of sand or clay, the wood is still subject to decomposition, though the decay is of a very different order and much less complete. The oxygen is the most active element of the wood, and the first to leave; but it never goes alone, always taking with it some of the hydrogen in the form of water, or of carbon as carbonic anhydride. Afterwards other portions of the carbon and hydrogen unite and make their escape as the inflammable gaseous substance known as marsh gas. The presence of this gas in most swamps and marshes attests that nature's laboratory for the manufacture of coal and bitumen is still in operation. Both these species of decomposition, whether in the air or out of it, go on much more rapidly in the presence of heat; the first process being exemplified in every stove and furnace, and the second by the charcoal pit; for anthracite, the ultimate product of slow decomposition out of contact with the air, is simply a mineral charcoal.

A further inspection of our formulas will make it evident that to transform cellulose or wood into the average bitumen we must remove all the oxygen, some carbon and but little hydrogen; while for the conversion of vegetable matter into coal, the oxygen is less completely removed, and the hydrogen suffers much greater loss than the carbon. In the one case the escaping volatile products of the decomposition are mainly carbonic anhydride with some marsh gas; and in the other case the loss has occurred chiefly in the form of water, the carbon remaining largely intact. This is an important difference, and one which would be more obvious if our series included all the varieties of coal. The fact is this series is not a very natural one after all. It represents fairly well the changes resulting in the production of the different bitumens, viz: a complete abstraction of the oxygen and a gradual diminution of the hydrogen; but the coals are generated

by a gradual diminution of both elements, as the following series will show, the formulas being still computed for comparison with cellulose :

Peat and Brown coal		$C_{24}\,H_{30}\,O_{10}$
Lignite		$C_{24}\,H_{24}\,O_{7}$
Bituminous coal	varies from	$C_{24}\,H_{20}\,O_{2}$
	to	$C_{24}\,H_{18}\,O$
Anthracite	varies from	$C_{24}\,H_{10}\,O$
	to	$C_{24}\,H_{6}\,O_{.3}$

We are, then, to regard the coals and bitumens as forming two distinct but parallel series, in each of which there is an evident tendency to the reduction of organic matter to the state of pure carbon. Theoretically, at least, the final results, like the starting points, are chemically the same for the two series; but they are reached by different roads. Graphite, which is essentially pure carbon, is the final term of the coal series, and it is not improbable that *diamond* stands in the same relation to the bitumens, for Liebig has suggested that diamond is most probably formed by crystallization of carbon from a liquid hydrocarbon.

Oxygen and hydrogen exist in cellulose in the right proportions to form water, and the conversion of this substance into coal, as already stated, consists mainly in the union of these two elements. But we may now profitably notice some important observations of Principal Dawson, according to which we should no longer regard the ordinary vegetable fibre or cellulose composing the main body of plants as the principal source of coal, but certain epidermal tissues which differ from cellulose in being much poorer in oxygen. In other words, it is the bark mainly, and not the solid wood from which coal is formed. Dr. Hunt gives the composition of cork, which is a bark, as $C_{24}\,H_{37}\,O_{7}$. These cortical tissues, Dawson says, "are very little liable to decay, and resist, more than most other vegetable matters, aqueous infiltration, properties which have caused them to remain unchanged and resist the penetration of mineral substances more than other vegetable tissues. These qualities are well seen in the bark of our American white birch (*Betula alba*). It is no wonder that materials of this kind should constitute considerable portions of such vegetable accumulations as the beds of coal, and that when present in large proportion they should afford richly bituminous beds. All this agrees with the fact apparent on examina-

tion of common coal, that the greater number of its purest layers consist of the flattened bark of the sigillariæ and similar trees, just as any single flattened trunk imbedded in shale becomes a layer of pure coal. It also agrees with the fact that other layers of coal, and also the cannels and earthy coals, appear under the microscope to consist of finely comminuted particles, principally of epidermal tissues, not only of the fruits and spore-cases of plants, but also of their leaves and stems."

Every one, I think, must have observed, at some time, decaying logs, or better, stumps, of which little or nothing remains but a cylinder of bark, and this is apparently little altered. Dawson has found such hollow stumps in the coal formation, with abundant evidence that they had been the homes of animals, such as insects and reptiles. Such phenomena are the best illustrations of the superior resistance which this class of vegetable tissues offers to atmospheric action, a resistance undoubtedly due to the small proportion of oxygen which they contain; their composition, as Dr. Hunt has pointed out, approaching closer to resins and fats than to wood, and, "like these substances, they repel water, with which they are not easily moistened."

We have now traced to their origin in the vegetable kingdom all of the coals, so far as known, and many of the true bitumens. The notion is rapidly gaining ground among geologists, however, that the bitumens, especially the lighter and more fluid forms, such as petroleum and naphtha, are largely of animal origin. This view, for the development of which we are mainly indebted to Dr. T. Sterry Hunt, is based upon the following general considerations: (1) Animal tissues, the average chemical composition, but not the molecular structure, of which may be represented by the formula $C_{24} H_{38} N_6 O_4$, approaches even more nearly than epidermal vegetable tissues to the composition of bitumens. (2) Although, as a rule, eminently unstable compounds, subject, under ordinary circumstances, to rapid and complete decomposition; yet we have good reason to believe that there are vast regions where the conditions are not only favorable for, but must necessitate, that slow and partial decay resulting in the formation of bituminous substances. The regions referred to are the depths of the ocean. Recent researches have shown, contrary to the old idea, that the deep sea holds an abundant fauna. All grades of animal life, from the highest to the lowest, have need

of a constant supply of oxygen. Now on the land, vegetation is constantly returning to the air the oxygen consumed by animals, but in the abysses of the ocean vegetable life is scarce or wanting, and hence it must result that over these greater than continental areas countless myriads of animals are living habitually on short rations of oxygen, and in water well charged with carbonic anhydride, the product of animal respiration. As a consequence, when these animals die their tissues do not find the oxygen essential for their perfect decomposition, and in the course of time become buried, in a half decayed state, in the ever increasing sediments of the ocean floor. The same thing must happen to animals living in higher bathymetric zones, all the way to the surface, whose bodies sink to the bottom after death; they yield a little ammonia and carbonic anhydride, and then pass into the comparatively stable condition of a liquid or solid bitumen. During the lapse of ages these sediments, rich in organic matter, will be consolidated into limestones and slates, and at a later period may be elevated to form new land; a process which has been many times repeated in the past. (3) For, as geologists well know, rocks corresponding to those just described are of very frequent and extensive occurrence among the formations now exposed to their observation.

Petroleum is usually associated with salt, the same well often affording both oil and a strong brine; a fact very suggestive of the marine origin of the petroleum. While the disagreeable smell of some oleiferous limestones is probably due, as remarked by Newberry, to the animal origin of the oil.

The capability which the so-called bituminous coals possess of yielding, by a process known to chemists as destructive distillation, various liquid and gaseous hydrocarbons, some of which resemble petroleum, a property common to most substances of organic origin, has not only led to their being erroneously regarded as bituminiferous, but many geologists have inferred that we have here a clew to the origin of the vast reservoirs of petroleum known to exist in this and other countries, and which have of late years been tapped with such astonishing results. Anthracite is undoubtedly a species of natural coke, produced when ordinary bituminous coal loses its volatile ingredients; its general mode of occurrence and geological relations prove this. But is nature's mode of making coke strictly analogous to what

goes on in the retorts of the gas works? Probably not. We have every reason to believe that the natural process is a very gradual one, and that the volatile products are all gaseous. In every bituminous coal mine in the world the two permanent gases, carbonic anhydride and marsh gas—the deadly choke-damp and fire-damp of the miners, are constantly escaping from the coal, but unaccompanied by any oily, petroleum-like liquid. This action, sufficiently long continued, must result in the production of anthracite, and that it has so resulted is evidenced by the fact that the rocks lying above the great deposits of anthracite are quite free from the liquid bitumens we should otherwise expect to find there. The fact is, that in Pennsylvania the anthracite is in one end of the State and the petroleum in the other; and, moreover, the petroleum is obtained from a formation below the Carboniferous, to which the coal belongs. Its origin is sometimes referred to the carbonaceous shales or pyroschists of the underlying Hamilton beds; but these, like the coals, are found, on examination, not to contain any bitumen, and like the bituminous coals, they still retain perfectly the power of yielding bitumens when sufficiently heated. Beyond the limits of Pennsylvania the general facts are the same, and nowhere is there any evidence proving a connection of the petroleum with the coals or pyrochists. Petroleum is generally obtained from wells sunk in sandstone or slate. In some cases it is probably indigenous in these, but usually it has been forced up by hydrostatic pressure or sponge-like absorption from oleiferous limestones. There are several extensive formations of these limestones in Eastern North America, and geologists are only beginning to appreciate their abundance and richness. The oil is found filling the pores and cavities of fossil shells and corals, and saturating the entire substance of the limestone, the evidence being plain that it is indigenous in this position and has not been introduced into the limestone subsequent to the formation of the latter. Dr. Hunt has made a quantitative determination of the petroleum in a limestone of Niagara age occurring near Chicago, with the following almost incredible result: Although the formation has a thickness of only thirty-five feet, yet in each square mile it must contain not less than "seven and three quarter millions of barrels of petroleum." He says further, "The total produce of the great Pennsylvania oil region for the ten years from 1860 to 1870 is

estimated at twenty-eight millions of barrels of petroleum, or less than would be contained in four square miles of the oil-bearing limestone formation of Chicago."

As a rule limestone is too massive and close grained to permit the oil to flow freely through it to supply wells sunk in this rock; but overlying sandstones gradually soak up the oil, and its accumulation along the crests of anticlinal arches in the latter rock is due to the presence of water in the strata, which, being the heavier liquid, forces the oil to the top. The richest wells are those which tap large bodies of oil contained in the great fissures and cavities which, as geologists well know, usually accompany an anticlinal fold of the strata. Very often these subterranean chambers are filled partly with oil and partly with gas, and the latter serves a useful purpose in forcing the former to the surface. This gas is derived from the oil itself, and if the situation of the fissure or the texture of the rock are such that the gas can escape, its formation will continue until, in some cases at least, the petroleum is reduced to a thick viscid or even solid condition. It is by a similar but more rapid fractional distillation that the petroleum is refined for illuminating purposes, the solid residue being chiefly the substance paraffine. The fissures filled with solidified or inspissated petroleum are not wholly theoretical, for several have been discovered, which, through some accident of erosion or faulting of the strata, are now exposed on the surface. The most noted of these is in New Brunswick, the material occupying the fissure being the famous and valuable mineral, albertite. This is a jet-black lustrous substance intermediate in physical characters between bituminous coal and asphaltum, though chemically it is much nearer the latter than the former, affording the formula $C_{24} H_{22} O_{1.6}$. This deposit bears no resemblance to a true coal bed, but fills a large irregular crevice cutting across the strata. The enclosing shales are rich in the remains of fish, and so bituminous as to be visibly oily, and to "sustain a fire without the aid of other fuel." The grahamite of West Virginia is a substance closely resembling albertite and occurring in a similar fissure or crevice. The same phenomena, on a smaller scale, are many times repeated in Canada, in the vicinity of Quebec and elsewhere.

Whenever petroleum is exposed to the air for any length of time, as when it slowly exudes from the rocks, forming petroleum

springs, it is likely, in a manner similar to that just described, to lose its more volatile ingredients and become semi-solid like mineral tar, or solid like asphalt. And so it happens that many of the smaller deposits of asphaltum in this and other countries are simply dried up petroleum, and are of animal origin. The great deposits of the globe, however, those which constitute the principal source of the asphaltum employed in the arts, do not appear to have been formed in this way; but have, in most cases at least, been derived directly, after the manner of coal, as already explained, from decaying vegetation.

Extensive deposits of asphaltum, such as that for which the island of Trinidad is celebrated, are commonly regarded as something exceptional, something out of the natural order, a freak of nature. This notion is without foundation in facts, for asphaltic substances are not only widely disseminated, as already stated, but in not a few localities, which form a zone girdling the earth, they are accumulated in such vast abundance as to ensure an unfailing supply for man's purposes for all time to come.

A list of the localities where asphaltum is especially abundant may further enforce this view, these are: Cuba, several of the Windward islands, especially Trinidad and Barbadoes, the Caribbean shore of South America, particularly the province of Maracaybo, Caxitambo and Berengela in Peru, where are lakes of asphalt similar to that on Trinidad; Mexico, Texas and California in North America, Persia and Arabia, Palestine on the shores of the Dead sea and on Mount Lebanon, Ionian islands, France, Switzerland and Portugal, It is a curious fact that the asphalts are confined almost wholly to tropical and sub-tropical regions. There appears to be in low latitudes some general climatic or other condition which has in many cases determined the conversion of vegetable matter into bitumen instead of coal.

The largest deposit in Europe is probably that in the Val-de-Travers, Neufchatel, Switzerland, which has been worked for more than one hundred and fifty years. This occurs in rocks of Cretaceous age; but as a rule the great masses of asphalt are found in connection with Tertiary strata. This is the geological position in Trinidad, Barbadoes, Peru and other points in South America and in California. Trinidad is composed chiefly of Tertiary and Secondary beds, the former predominating; but toward the north the island otherwise quite low, is bordered by a bold

range of mountains, a detached link of the great littoral Cordillera of Venezuela. These are composed of ancient crystalline strata, and stand like a wall between the Tertiary plain on the south and the Caribbean sea, and the long chain of volcanic islands on the north. There is scarcely a trace of true volcanic action observable in Trinidad, the hot mud springs—the so-called mud volcanoes—hardly coming in that category. They may be classed as hydro-thermal but not as igneous phenomena. I have also seen little or no evidence of volcanic action during the past epochs in the history of the island; and the frequent severe earthquake shocks of the regions on the west and north are very rarely felt with destructive force in this favored isle.

Asphaltum, usually accompanied by mineral tar and petroleum, occurs at many points on Trinidad and also on the adjacent main. But the largest and most interesting deposit, not only of this region but of the world, is that known as the Pitch Lake. This is on Point La Brea (La Brea being Spanish for *the pitch*), in the south-western part of the island, and one mile from the Gulf of Paria. The topography of the country about the lake is extremely simple; from three sides—north, west and south—the land slopes gradually upward from the sea to the surface of the lake, which lies one hundred and thirty-eight feet above the gulf; while on the east the land is slightly higher than the lake. In other words, the Pitch Lake is on the faintly-marked shoulder of a broad, low ridge which, projecting into the gulf of Paria, forms the peninsula or promontory of La Brea. Contrary to all topographic laws and precedents, this so-called lake is not in a valley, but on a hill-top. I have already denied the existence, both past and present, of volcanic phenomena in this region, and yet the situation of this remarkable deposit of asphalt is very much as if the broad-mouthed crater of a low-lying volcano were filled to the brim with this material. I say filled to the brim, because on the three sides named above, the surface of the pitch is even with the brow of the hill, and more so, for at many points the viscous substance is constantly overflowing and moving seaward, after the manner of very sluggish lava streams. The motion is extremely slow, the pitch, where it issues from the lake, being a brittle solid. The moving masses present curved lines and surfaces, which are convex downwards; and Kingsley has very aptly likened these streams of asphalt to glaciers, the lake representing a *mer de*

glace. The asphalt becomes harder the longer it is exposed to the air and the sun, through loss of its volatile ingredients, and consequently the downward progress of the "black glaciers" must sooner or later be checked, if not entirely stopped. It seems impossible to determine the extent of the overflow, for although the entire slope from the lake to the sea appears as a continuous stratum of pitch, the soil being everywhere very thin or entirely wanting, yet it is probable, as pointed out by Messrs. Wall and Sawkins,[1] that the most of this superficial sheet has exuded from the asphaltic sandstone—a sandrock supersaturated with asphaltum—which forms the rocky basis of that portion of the ridge where the free asphalt is found. The area covered or underlaid by this mantle of pitch is estimated at 3000 acres.

The bitumen is certainly not injurious to plant life, for the scanty soil covering the pitch, and consisting largely of that material in a pulverulent state, supports a luxuriant vegetation. The village of La Brea, on the shore, with the boiling houses where the asphalt is refined, rests on the pitch; and the inhabitants complain that their houses are liable to be thrown out of level by the rising or sinking of the tarry foundations. It seems as if everything superficial here, vegetation, houses, roads, etc., must be slowly but surely drifting toward the sea.

"It is fortunate," as one writer has remarked, "that the pitch when compact will not kindle, or in other words will not burn without a wick, for otherwise the entire region, including the village, might suffer the fate of Sodom and Gomorrah."

The pitch not only forms the sea-shore for the greater part of a distance of four miles, but in front of the village it appears from beneath the sea as a solid barrier reef some hundred yards from the shore, which is a source of danger to unwary boatmen when the water is rough. It is probable that this peninsula of La Brea owes its existence to the protection afforded the land by the asphalt, which resists the action of the waves and running water far better than the unconsolidated clays and sands forming the coast to the north and south.

We may now return to the fountain head, the lake. Of the various published descriptions of this remarkable phenomenon, there are very few that can justly lay any claim to accuracy, and strange to say these are not to be found in encyclopedias, nor even in our best text books of science. Probably no object in

[1] Report on the Geology of Trinidad.

nature has been so grossly misrepresented as the Pitch Lake of Trinidad. In an official history of the English Exposition of 1851, under the head of descriptions of articles from Trinidad, it is stated that, "The Pitch Lake is on the highest land in the island. It is soft and fluid at the center, and there is an active submarine volcano near the coast." I have already given the true altitude of the lake as one hundred and forty feet, while the highest point on the island is Mt. Tucutche, 3100 feet above the sea. The submarine volcano is a petroleum spring which comes up under the water a short distance from shore; the water is visibly oily over an area of several rods, and bubbles of gas are sometimes seen to escape, but nothing farther, though another writer speaks of this as "a submarine volcano which at times makes a noise like thunder and emits naphtha and petroleum." The lake itself is usually described as three miles in circumference, hot and fluid in the center, but cold and solid toward the shore. In point of fact this body of pitch, which is of approximately circular outline, is scarcely one and one-half miles in circuit, and there is no part of its surface that may not be walked upon with impunity. The temperature is uniform throughout. The area of the lake is ninety-nine acres. Its surface, soft enough in a few spots to receive the impression of a man's boot, is for the most part quite hard and firm, and everywhere of a dull earthy-brown or brownish-black color. The fracture is eminently conchoidal, but the lustre is always dull, the result of an admixture of twenty to thirty per cent. of earthy matter, sand and clay. These impurities are removed by boiling, and the pitch then becomes shining black and still more brittle.

There are some twenty or more patches on the lake, five to fifteen yards in diameter where soil has collected and vegetation —trees, shrubs and grasses—has gained a foothold, forming green islands or oases. The surface presents many small dome-shaped swellings or protuberances, from an inch to a foot in diameter; these pitch bubbles are always hollow, and contain traces of the lighter portions of vegetation in a half decayed state, the thin covering appearing to have been raised by gases given off from the decomposing leaves and twigs, or liberated by the sun's heat from the pitch itself. Excavations made in the pitch show that below the surface these cavities or vesicles are exceedingly numerous; they are usually almond-shaped or ellipsoidal, being

flattened by pressure, and though always the result of gaseous expansion, are commonly filled with water; in fact the entire mass of the pitch is saturated with water, so that even where quite soft it will not soil the hands, because the water oozes out and prevents adhesion. The earthy impurities of the pitch also assist in rendering untrue, in this instance, the old proverb that one cannot touch pitch without being defiled.

The pitch is mined or quarried by excavating areas thirty or forty feet square to a depth of two to four feet. As soon as the work ceases on one of these cellar-like excavations the surrounding asphalt, seeking to restore the equilibrium, begins to obliterate it, the walls not closing in perceptibly but the bottom rising up, and in a few days no trace of the opening remains. This is only one of many indications of greater fluidity below the surface. The plasticity of the pitch is evidently due to the oily matter which it contains, and not in any sensible degree to the temperature. Hardened bitumen, it is true, may be fused by the application of sufficient heat, but that which is naturally fluid remains so at all ordinary temperatures. As already explained, when the asphalt is exposed to the air it becomes solid through loss of its volatile ingredients. Towards the center of the lake are several detached areas, a rod or two in breadth, which are softer than the rest of the surface, and yield under the feet, "so that on standing a few minutes one feels that he is gradually settling down, and in the course of ten or fifteen minutes he may find himself ankle deep." "But," as Mr. Manross[1] truly says, "in no place is it possible to form those bowl-like depressions round the observer described by former travelers." Nor is it probable that Kingsley is right in saying, "No doubt there are spots where, if a man stayed long enough, he would be slowly and horribly engulfed." The inferior density of the human body would prevent its submergence even if the pitch were quite fluid.

In the vicinity of these places many small streams of gas escape from the pitch. The evil smell and the deposit of sulphur left on the pitch tell us that the gas is chiefly sulphuretted hydrogen; but the sulphurous odor ceases to be perceptible at a distance of a few rods, and does not extend for ten or twelve miles, as some writers have asserted.

The surface of the lake does not present a continuous sheet of asphalt, but is traversed by a net-work of channels in which the

[1] American Journal of Science, 1855.

rain-water collects. These anastomose and divide most curiously, forming one connected system, and dividing the pitch into numerous flat-topped or slightly convex areas or islands which are usually of quite irregular outline, though sometimes nearly circular, and from ten to one hundred feet in diameter. A piece of marbled paper would make an excellent map of the lake. The sides of the channels are always convex, presenting curves of great regularity and beauty; and where three or four channels meet, a star-shaped depression is formed. Canon Kingsley[1] says, "Conceive a crowd of mushrooms, of all shapes, from ten to fifty feet across, close together side by side, their tops being kept at exactly the same level, their rounded rims squeezed tight against each other; then conceive water poured on them so as to fill the parting seams. Thus would each mushroom represent, tolerably well, one of the innumerable flat asphalt bosses which seem to have sprung up, each from a separate center, while the parting seams would be of much the same shape as those in the asphalt, broad and shallow atop, and rolling downward in a smooth curve till they are, at bottom, mere cracks from two to ten feet deep. Whether these cracks actually close up below and the two contiguous masses of pitch become one, cannot be seen. As far as the eye goes down they are two, though pressed close to each other," the hard exteriors of the masses preventing them from coalescing.

The water filling the channels is clear, pure rainwater, and contains numbers of small fishes, water beetles and other aquatic animals. It has been observed escaping from the canals at eight nearly equidistant points on the circumference of the lake.

Several hypotheses have been proposed to account for the peculiar structure of the lake. Mr. Manross says, "The channels are produced and maintained by the following singular process: Each of the many hundred areas into which the lake is divided possesses an independent revolving motion in this wise: In the center of the area the pitch is constantly rising up *en masse*, displacing that which previously occupied the center, and forcing it towards the circumference. The surface becomes covered with concentric wrinkles and the interior structure somewhat laminated. Where the edge of such an expanding area meets that of the adjoining one the pitch rolls under to be thrown up again in the center at some future period. It is difficult to conceive of a

[1] At Last: A Christmas in the West Indies.

motion like this going on in a material almost of stony hardness, but that such a revolution is constantly taking place over the entire surface of this black lake cannot be doubted. The conclusion then to which a close observation leads us in regard to the present condition of this singular lake is, not that it has suddenly cooled down from a boiling state as heretofore described, but that solid as the material is, it is still boiling, although with an indefinitely slow motion. As the descent of the glaciers may be considered the slowest instance of flowing in nature, so the revolutions of the scarcely less solid bitumen of this lake may be set down as the slowest example of ebullition."

Messrs. Wall and Sawkins, on the contrary, deny the existence of the revolving motion, and consider that each of the areas represents a center of emission where the asphalt has issued from the underlying sandstone, "and gradually advanced until the material from the surrounding foci being encountered, further progression was impeded, and the accumulation proceeded in the vertical in place of the horizontal direction." But the present level of the lake has evidently been maintained for ages, and consequently it is difficult to see why, if this view is correct, the asphaltic bosses have not flattened out and closed up the water channels.

Neither of these views can be regarded as entirely satisfactory. Mr. Manross is undoubtedly right as regards the circulation, though in error as to its cause. He finds unique and conclusive evidence of the revolving process in "numerous pieces of wood which being involved in the pitch are constantly coming to the surface. They are often several feet in length and five or six inches in diameter. On reaching the surface they generally assume an upright position, one end being detained in the pitch while the other is elevated by the lifting of the middle. They may be seen at frequent intervals all over the lake, standing up to the height of two or even three feet. They look like stumps of trees protruding through the pitch, but their *parvenu* character is curiously betrayed by a ragged cap of pitch which invariably covers the top and hangs down like hounds' ears on either side." These fragments of wood are of the same recent origin as the leaves and twigs contained in the vesicles of the pitch. From the surrounding forest or the green islands of the lake itself, they have found their way into the water channels,

become water-logged, sunk to the bottom and been drawn down by the ever-revolving pitch.

In one case at least within my observation, a recently detached portion of one of the islands of vegetation afforded incontestable evidence of a horizontal movement of the subjacent pitch to the extent of several feet.

According to the present writer, the true cause of the revolving motion of the pitch, and of the structure resulting therefrom, is found in a fact pointed out by Wall and Sawkins, but not insisted upon or fully appreciated by them, viz: the great diurnal range in the temperature of the surface of the pitch. On unclouded days the asphalt attains an average temperature of about 140° Fahr., and sinks during the night to 70° or 60°, suffering a variation of 70° to 80°, which must produce a considerable change of volume, especially if we consider the vesicular nature of the pitch and the quantity of water which it contains. This expansion will be superficial, and its chief tendency to extend the pitch horizontally. Where the pitch is covered by water it will not experience this alteration of volume. The courses of the water channels may have been determined originally by slight inequalities of the surface, holding shallow sheets of water, or drifting sand may have occupied these positions and served to protect the asphalt along these lines from the heat of the sun. The main point is that the protected areas would be forced downwards by the expansion of the unprotected areas, and this motion once established would continue without interruption until the contours of the present surface were developed.

Nocturnal radiation and consequent contraction could not undo the effect of the diurnal expansion, but the equilibrium would be and doubtless is maintained by the elevation of pitch from below in the center of the areas. The plastic pitch beneath the solid crust is sometimes forced upwards through the crevices in the bottom of the channels. One interesting example of this is described by Mr. Manross: " In one of the star-shaped pools of water, some five feet deep, a column of pitch had been forced perpendicularly up from the bottom. On reaching the surface of the water it had expanded into a sort of center-table about four feet in diameter, but without touching the sides of the pool. The stem was about a foot in diameter. I leaped out upon this table and found that it not only sustained my weight but the elasticity of the stem enabled me to rock it from side to side. Pieces torn

from the edge of this table sank readily, showing that it had been raised by pressure and not by its buoyancy."

No soundings have ever been made in this lake and its depth is unknown. The thickness of the deposit is of course a factor of the first importance in determining whether the supply of asphalt from this locality is likely to prove practically inexhaustible in view of the steadily increasing demand for this material in the arts. According to Wall and Sawkins each foot in depth is equivalent to 158,400 tons, and they assume the maximum average depth at thirty feet, making the total supply 4,752,000 tons. Judging by the uniformity of the asphalt and the size of the revolving areas, the true mean depth must considerably exceed this estimate. It is believed that the pitch could be readily excavated to a depth of ten or fifteen feet, and from that level iron bars could probably be forced to the bottom and the true depth accurately ascertained. In considering the question of the probable permanence of the supply, it is important to remember that the material is doubtless still escaping from the underlying asphaltic sandstone, though perhaps very slowly.

As regards its origin, the lake is believed not to differ essentially from any of the patches of pitch scattered over the surrounding country except in this, that the form of the surface has been more favorable for its accumulation. It appears to be simply a large puddle of pitch, which has oozed out of the sandstone and collected in a basin-like depression in that rock.

The observations of Mr. Wall have placed the vegetable origin of this bitumen beyond question. The asphaltic sandrock is rich in vegetable remains, and it is possible to trace every step in the conversion of these into asphaltum, until the organic texture of the wood is entirely obliterated and pure bitumen results, the external form of the wood alone remaining.

The fact that the Island of Trinidad lies between a portion of the delta of the Orinoco and the sea, long ago led Sir Charles Lyell to adopt the view that the asphalt deposits of Trinidad, including the Pitch Lake, which is on the side of the Island towards the delta, represented the drift wood brought down by the Orinoco in past geological ages. But I believe he afterwards concluded that this explanation, like the wood itself, was rather far-fetched. For it can be proved that at the time (Miocene period) when these asphaltic beds were forming, the mouth of the Orinoco was some one hundred and fifty or two hundred miles ***further up*** stream than at present.

NOTES ON AN EXTENSIVE DEPOSIT OF OBSIDIAN IN THE YELLOWSTONE NATIONAL PARK.

BY WM. H. HOLMES.

CONSIDERABLE deposits of obsidian and obsidian porphyries had been observed in the national park previous to our visit in the summer of 1878, but no satisfactory exposures of the glassy varieties had been found. In October I had occasion to make examinations of a locality particularly rich in them, situated in the north-western part of the park, near the head of Obsidian or Alum creek, a tributary of the middle fork of Gardiner's river. The crumbling trachytes of this part of the park give, in general, a rounded and monotonous character to the topography. The slopes of the valleys are gentle excepting at points where the glassy rocks predominate.

In ascending Obsidian creek, by way of the newly-cut wagon road which connects Mammoth Hot Springs with the Geyser Basins, we pass first through broad meadows and parked forests. Farther on the valley narrows up and the timber becomes extremely dense. At a point about twelve miles above the junction of the creek with the main stream, there is a narrow gateway known as Obsidian cañon, through which the road and creek pass. From the east side of the valley a low promontory extends forward to the creek and breaks off in an abrupt nearly vertical wall, in which the obsidian rocks are exposed. The road approaches the cañon along the west side of the valley, and crosses to the east side at the lower end of the cañon; in order to avoid the swampy ground that borders the stream it has been carried across the steep débris slopes of the obsidian cliffs. For half a mile it is paved with glassy fragments and lined by huge angular masses of black and banded obsidian rock. From the upper border of the débris slope the vertical cliffs rise to the height of nearly two hundred feet. The lower half is composed of a heavy bed of black obsidian which exhibits some very fine pentagonal columns, somewhat irregularly arranged and frequently distorted, but with perfectly cut faces that glisten in the sunlight. The upper portion of the wall is composed of a much more obscurely columnar mass of impure spherulitic obsidian, the rude faces of the columns being often as much as ten or twelve feet across. To the right and left the columnar character becomes

less marked, both in the upper and lower part of the cliff, and farther out seems to be entirely lost, the glassy rocks grading into the gray sanidine trachytes and obsidian porphyries of the surrounding hills.

Extending upward from the edge of the promontory in a moderately gentle slope are four or five hundred feet of obsidian strata that exhibit some most interesting characters. There is no heavy mass of pure glassy rock, but a succession of irregular layers of a dozen or more varieties of spherulitic obsidian, obsidian porphyries and breccias. The colors of these rocks are exceedingly varied, the prevailing blacks giving way to reds, browns, greens and the richest possible marblings and mottlings.

One of the most striking characteristics of these rocks are the spherulitic concretions which occur to a greater or less extent in all the varieties. These bodies seem to prevail in the ashy-like bands or layers which, in the more compact mass toward the base, are frequently contorted, giving the rock the appearance of a banded and contorted gneiss. The ashy-appearing layers are probably composed of the same material as the concretions, since when we split the rock *with* the bands, the surfaces of the gray bands next the glassy layers are simply a connected or coalescent series of nodes or hemispheres which have the usual appearance of the more isolated concretions. Where the concretions are scattered throughout the glassy mass, they are globular or composed of a cluster of globes. They have, in most cases, a distinctly radiated structure, with not infrequently concentric layers near the surface. The interior is gray or pinkish-gray, and the surfaces, pinkish or flesh colored.

In the coarsely columnar part of the wall the spherulites are often a foot or more in diameter and appear much flattened and distorted. It is probable that these irregular forms are produced by the coalescence of a large number of smaller ones, as there are apparently many centers of radiation. Large beds of the rock seem to be made up almost wholly of the concretions, and where decomposed, a mass of coarsely cellular or honey-combed obsidian remains. The brecciated beds consist of an ashy matrix in which are imbedded angular fragments of every variety of the brilliantly-colored spherulitic and ordinary obsidians.

The collection of hand specimens made at this place is very complete, numbering upwards of three hundred. Their examina-

Fig. 1.

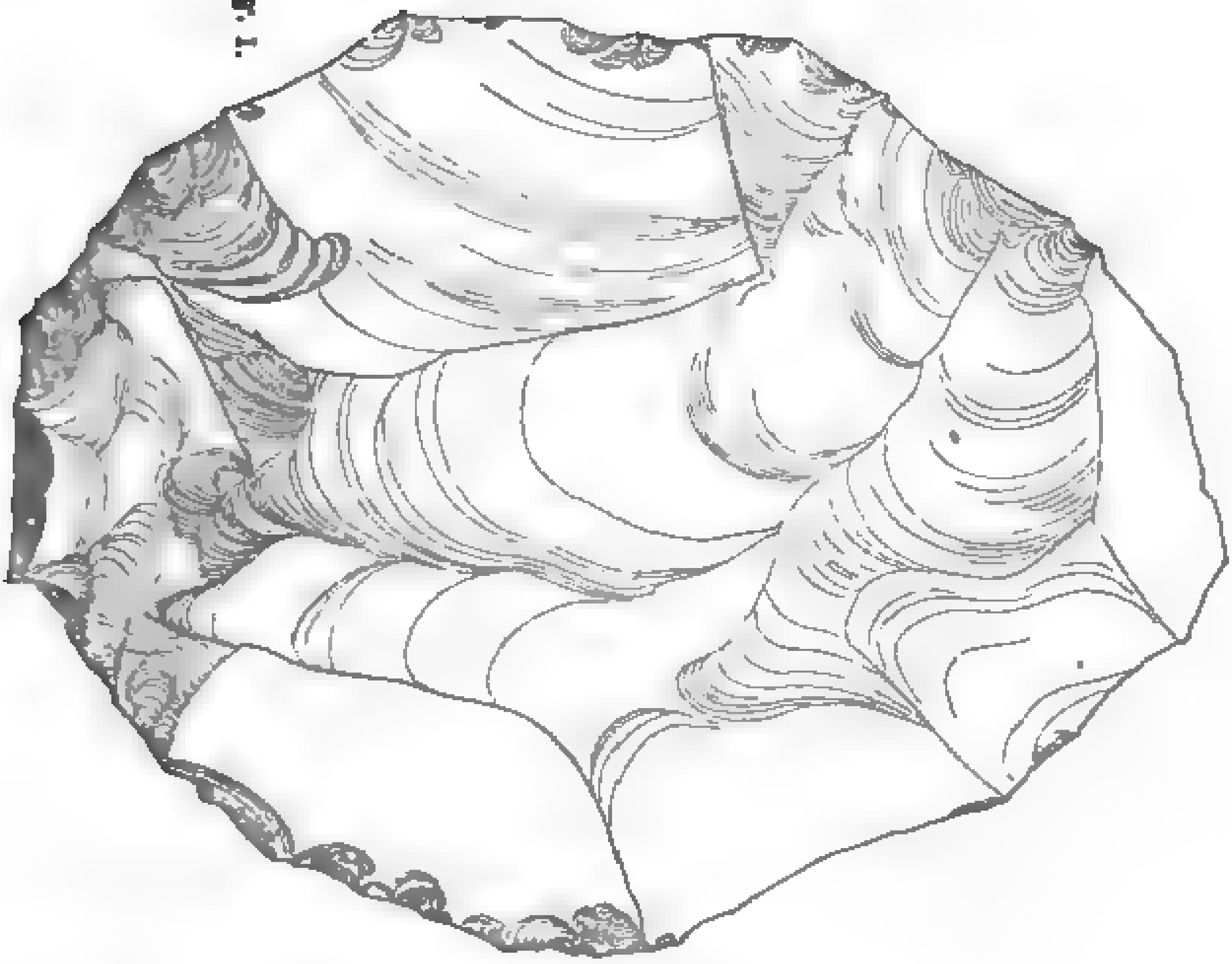

Fig. 3.

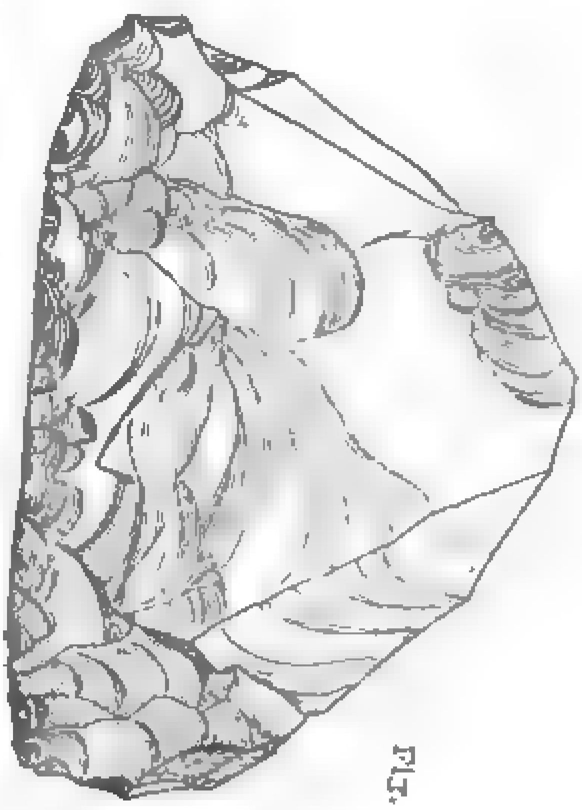

Fig. 2.

tion by specialists in petrography will doubtless develop many new and interesting features, as no equally rich deposit of similar rocks has heretofore been brought to their notice in this country.

Indian Implements.—It occurred to me, while making examinations at this point, that the various Indian tribes of the neighboring valleys had probably visited this locality for the purpose of procuring material for arrow-points and other implements. A finer mine could hardly be imagined, for inexhaustible supplies of the choicest obsidian, in flakes and fragments of most convenient shapes, cover the surface of the country for miles around.

Having climbed the promontory, I observed that an old but quite distinct trail passed along the brink of the ledge and descended the broken cliffs to the valley above and below. In the vicinity of the trail the glistening flakes proved to be more plentiful than elsewhere, and were also apparently gathered into heaps. After a short search a leaf-shaped implement of very fine workmanship was found; it is made of the black opaque obsidian, and is four inches in length, three inches in width and one-half an inch in thickness; an outline of this implement is given in Fig. 1. Having continued the search as long as the time at my command would permit, I was amply rewarded in the possession of ten more or less perfect implements. Three are leaf-shaped and nearly the same in size as the first specimen found, but imperfect from having been broken. One is somewhat pyramidal in shape, as shown in Fig. 2; the bottom is flat, the flaked surfaces extending from the base to the apex; it is two and a half inches in width and one and three-quarters in height, and is the only specimen in the collection that appears to have been in the least used; the sharp edge at the base is considerably worn; Fig. 3 is a top view of the same. Another specimen is triangular in shape with sides about three inches long; another is rectangular and about three inches wide by four in length, and still another is a rude oval; nearly all of these implements are imperfect, as it broken or unfinished. If we are to suppose that the great quantities of minute flakes are the fragments left from the manufacture of implements we must conclude that extensive supplies have been obtained here, but by what tribes or at what period it will be quite impossible to determine.

RECENT LITERATURE.

MACFARLANE'S GEOLOGISTS' TRAVELING HAND-BOOK.[1]—The design of this small octavo of two hundred and sixteen pages, which is well expressed in the title, is certainly novel. This is a distinctly new departure in geological literature; and it is surprising that it is so, since there has long been room for such a work. It supplies a want long experienced, for every geologically-minded traveler must have felt the need of a key or guide to the geology of the districts traversed. But the book is designed for the unscientific observer as well as for the professional geologist. In this connection the author says: "One object of the work is to teach persons not versed in geology something of this science during the tedious and unprofitable hours of traveling, without study, not as in a text book, but by pointing to the things themselves as seen at railway stations and through the windows of a railway car;" and it is not improbable that the chief value of the "Guide," as regards the interests of the science, will consist in the wider diffusion by right means of geological knowledge and interest which it will effect.

Forty pages in the first part of the book are devoted to brief but comprehensive descriptions, especially designed for unscientific travelers, of the different geological formations, beginning with the Eozoic, the divisions of which are those proposed by Dr. T. Sterry Hunt and the Canadian Geological Survey. The descriptions of these are from the pen of Dr. Hunt and are notable as constituting the first general account that has appeared in a popular work of those grand fragments of the material record of the earth's history which, whether we consider their volume or the length of time required for their formation, appear vastly more important than the corresponding divisions of the Palæozoic and later eras. From an economic point of view, too, the most of these primary Eozoic divisions are outranked by none of the more recent formations, except the Carboniferous. Following these descriptions are two tables of the geological formations, one by Prof. J. D. Dana similar to that in the second edition of his Manual, and the other by Dr. Hunt, which differs from Dana's chiefly in the divisions of the Eozoic and Cambrian. The former is principally followed in the subsequent portion of the work, which consists of one hundred and fifty-six pages of tables of railway stations, the railways being grouped according to States, while opposite the name of each station is the name of the formation occurring there, and in some cases the altitude above sea level. The nomenclature of the formations necessarily varies

[1] *The Geologists' Traveling Hand-Book.*—An American Geological Railway Guide, giving the geological formation at every railway station, with notes on interesting places on the routes, and a description of each of the formations. By JAMES MACFARLANE, Ph.D., with the coöperation of the State Geologists, and other scientific gentlemen. New York, D. Appleton & Co., 1879.

considerably in the different States, but a common number attached to them throughout the book, serves for their identification by whatever name they are called.

A majority of those having occasion to use this work, will probably regret the almost complete absence of references to palæontology and mineralogy, nothing being given in most cases beyond the mere name of the formation, with very rarely an allusion to its lithological character; so that we have here little more than a chronological guide. It is true the author tells us that to have included fossils, rocks and minerals in the scope of the work, would have made an unwieldly volume of what to be serviceable must be small; but this objection to fuller information appears less valid when we reflect that an addition of even fifty pages would not make the book inconveniently large, *i. e.*, it would still be smaller than many railway and tourists' guides, and that the characteristic fossils, rocks and minerals are not required for every station, but only for those points, comparatively few in number, where they are best developed and may be studied to best advantage; and then it would be quite unnecessary to name the fossils, except, perhaps, in a general way. That is, one usually likes to know, not only the name and extent of the formation he is traversing, but also the points along his route where its palæontologic, lithologic and other characters are most favorably exposed, as this will often determine the choice of a route and the stoppages to be made. To some extent the meagre information on these points contained in the tables is supplemented by foot notes; but these are copious only for New York, Pennsylvania and Virginia, while for the most of the States they are almost entirely wanting. The foot notes to the chapters on the Dominion of Canada and New England, for example, aggregate scarcely half a page, while for New York alone they amount to eight and one-half pages, and for Pennsylvania there are nearly six pages, and the great State of Ohio has not a single line.

On railroads where the stations are separated by short distances, the less important are sometimes omitted, but we are informed that this only occurs where the same formation is continuous across the break; a casual examination, however, shows that this precaution has not always been observed. The most important exception noticed is on the Boston and Albany railroad, in Massachusetts, where eight stations in succession are omitted between Brighton and South Framingham, although the two stations named are correctly marked as being on entirely distinct formations. Brighton and the five stations next to the west are on Cambrian, then come Grantville, Wellesby and Natick, on typical Huronian with a breadth of seven miles before we reach South Framingham, which is marked as Laurentian, though in the writer's view more probably Montalban.

Although the book is deemed susceptible of improvement in

the directions indicated, yet it contains a vast amount of valuable knowledge carefully tabulated, and is a highly creditable first step toward supplying a recognized want; and no traveling geologist —whether beginner, amateur, or professional—can afford to be without it. The binding is not all that could be desired for a work of this character, since the covers are neither stiff enough to resist bending, nor sufficiently flexible to bend without breaking.—*W. O. C.*

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Notice sur L'Ouvrage de M. le Professeur Heim intitulé: Mechanismus der Gebirgsbildung im Anschluss an die Geologische Monographie der Tœdi-Uindgæller-Cruppe. By E. Renevier. 8vo, pp. 9. (Ext. from Archives des Sci. Phys. et Natur. Nouvelle période, tome soixante-quatriéme No. 251. 15 Novembre, 1878.) Geneve. From the author.

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Annual Report of the Wisconsin Geological Survey for the year 1878. By T. C. Chamberlain, chief geologist. 8vo, pp. 51. Madison, 1879.

Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. 5. No. 1. 8vo, pp. 152. From the survey.

The Devonian Brachiopoda of the Province of Pará, Brazil. By Richard Rathbun. 8vo, pp. 14–39. (Ext. from Proc. Boston Soc. Nat. Hist., Vol. XX, May 15, 1878.)

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GENERAL NOTES.

BOTANY.

THE NUMBER OF STAMENS IN BRASENIA PELTATA.—There is quite a discrepancy among botanical writers regarding the number of stamens of *Brasenia peltata* Pursh, the common water-shield. A citation of a few of these, and some observations with a view to remove the differences, may not be out of place. My

attention was first called to this in 1872, when critically examining some specimens of the plant gathered at Bear lake, Van Buren county, Mich. The stamens were generally 24 or 25 in number. In 1875, specimens were collected at La Porte, Ind. My notes read, " Stamens indefinite, sometimes 27." They were usually not far from 24.

The past season it was found at Pine Lake county, Ind. The highest number of stamens noticed was 37, nearly always above 30, and commonly about 36. I also gathered specimens last summer at Old Mission, on Grand Traverse bay, Mich. The plants were advanced in flower and the stamens somewhat decayed, but were apparently 18 or less. In all these cases the stamens were picked out one by one, laid on a sheet of paper and counted, several flowers being taken in each locality. The conclusion from these facts is, that the stamens vary from about 18 to 37. It would be safe to say of the plant: stamens varying from 12 to some indefinite number.

Taking the most accessible authorities, especially in American botany, I find as follows: Gray's Manual, and Chapman's Flora of the Southern States, "Sta. 12–18." Gray's Structure and Systematic Botany, "Stamens definite, or nearly so." They may therefore slightly exceed 20. In Torrey and Gray's Flora of North America, Nuttall's Genera, Wood's Class Book (earlier edition), "Sta. 18–36. In Pursh's Plants of North America, Eaton and Wright's Botany (1840, genus Hydropeltis), Linnæus' Systema Vegetabilium (Sprengel's edition), "Class Polyandria," stamens 20 or more. In Rafinesque's Medical Botany of the United States (1828), " Sta. 20–30." In Michaux's Flora, under *Hydropeltis purpurea*, " Stamens numerous (about 36)." In Wood's Class Book, last edition, " Sta. 18–24." In Baillou's Dictionnaire de Botanique, Art. Brasenia, " Its stamens and carpels are indefinite." In Le Maout et Decaisne (Traité de Botanique) under Cabombeæ, including Brasenia, " Stamens 6, 12 or 18"—doubtless 12 or 18 for Brasenia, those of Cabomba being 3 or 6. In Eichler's Blüthen diagramme (1878), " Sta. 12–8."

From these references it is evident that there has been but little agreement as regards the number of stamens. While the older writers in general gave higher numbers, and in this more nearly accord with what I have found in the vicinity of Lake Michigan, yet it is probable that they are in error by not going below eighteen. Most of them also assigned the plant a southern or southerly habitat, on the Atlantic coast from New Jersey southward, west of the Alleghenies from Kentucky south. It may be that in these localities as in the north-west the number had a higher range. But the plants found in Northern Michigan would seem to indicate the lower number, and hence the entire range be covered by plants in this vicinity. This variation in number of stamens may be due to locality, or the season, or to

some inherent tendency in the plant itself. Consecutive observations in the same locality can best determine this. But this is immaterial to a correct statement in our text-books and works of reference. Assuming that all the authorities cited above are right, which may be shown to be true for some localities, as my experience in four localities proves, still there is need of a correction that shall include the experience of all. Eichler states the fact correctly, a conclusion I had already reached both from observation and a consultation of authorities, before receiving his book.

While collecting the facts for this paper I had noticed a tendency in the stamens to be multiples of six. Those found at Old Mission were apparently about 18 in number, those at Bear lake and La Porte about 24 (24–27), those at Pine about 36. This goes to confirm an observation of Nuttall (Genera, Vol. II, p. 24), which I had not read till arranging these facts for publication. Having stated that the stem is furnished with two sets of confluent central vessels, which, arriving in the leaf, resolve into twelve nerves, he continues: "As the elliptic form of the leaf originates from the eccentricity and duplicature of the central vessels, expanding in an ellipse or two intersecting circles, so we may justly consider it as a species of double leaf, hence also the stamina and the fruit is in the same manner augmented. In its coördinate *Cabomba*, which produces orbicular peltàte leaves, we find only 6 stamina instead of 18, two or three styles and capsules instead of six or more, but containing the same number of seeds and of nearly the same form; hence we perceive the same type in its simple form. A proof of the small importance of mere number in the character of classes or of natural groups."

From this the inference is obvious that the doubling of the stamens would be in multiples of six. A plant with a tendency to double stamens that ranged between 12 and 18, would have from 24 to 36; those approximating the simple type *Cabomba* would be intermediate from 12–18, 18–24, 24–30, 30–36, &c.

Doubtless it is better to go back of this and say that the stamens are multiples of the three or four parts of which the calyx and corolla consist. The perianth of *Cabomba* is on the whole trimerous, the parts alternating. Eichler states: "Brasenia does not essentially differ from Cabomba except in its 12–∞ stamens, and 6–18 pistils." (Blüthten diagramme, Part II, p. 177.)

Though the stamens are not exact multiples of three and four in all cases, they vary but a little from it.—*E. J. Hill, Englewood, Ill.*

A Fairy Ring.—Last July my attention was called to a "Fairy Ring" on the lawn in front of a gentleman's residence in this city. It was a more perfect circle than could have been made by man unaided by instruments. The rim of the circle was about twelve inches in width, and the diameter from the inner edge about fifteen

feet. The lawn was covered with grass some three or four inches in height, and every blade forming the circle, was found on close inspection to be covered with minute globular bodies of a grayish color which, contrasting with the green of the lawn, made the circle perceptible at a considerable distance.

On the morning of its discovery the ring was not completed by six or seven feet. The next morning it was finished. Two smaller circles were also seen on the same lawn; one however was incomplete where it encroached on a gravel walk. When the circle was struck a small smoke like cloud arose. On examining with a microscope the blades of grass which formed the ring, they were found to be covered with clusters of globular, sessile bodies from one-fortieth to one-sixtieth of an inch in diameter, which externally resembled minute puff balls. Specimens sent to Prof. W. G. Farlow of Harvard University, were pronounced by him to to be a fungus of the order Myxomycetes (*Physarum cinereum*).—*B. C. Jillson, Pittsburgh, Pa.*

INSECTS AS UNCONSCIOUS SELECTORS OF FLOWERS.[1]—Natural selection, the origin of new forms in the animal and vegetable kingdoms by the survival of the fittest, and artificial selection by man, agree in many points, though differing in others. In general they harmonize in the following respects. From generation to generation the number of individuals of every species in process of selection is increased, while the individuals of a given generation differ among themselves. Of these individuals, only such as surpass their fellows in certain directions are allowed to produce offspring; and these offspring inherit the peculiarities to which the prolonged existence of their parents is due. Hence we find that both modes of selection result in the accumulation of individual variations, all tending in a particular direction, so long as the conditions presiding over the survival of this or that individual remain constant. On the other hand, we find that these last conditions differ greatly in the two kinds of selection. Man arbitrarily destroys at once, or neglects all individuals which are neither pleasing nor profitable to him; while those which he spares become through successive generations more and more indicative of his wishes or needs. But natural selection preserves only such individuals as are best adapted to nourish and protect themselves and to produce offspring which may be widely disseminated, the offspring becoming from generation to generation better adapted to the performance of these duties. With flowers in a state of nature we find that the causes presiding over even the survival of individual forms are quite similar to those pertaining to human selection; for the insects which visit these flowers are guided like man by pleasure or profit; and, though they cannot weed out plants which do not satisfy them in either of these re-

[1] An abstract of a series of very interesting articles, entitled Die Insekten als unbewusste Blumenzüchter, by Dr. Hermann Müller, Kosmos, Band III, Heft 4–6.

spects, they can cease to visit them, and by this means cause their deterioration and final destruction through self-fertilization, while such as meet their wants are strengthened by repeated crossing. Here, then, we have to deal with something more than natural selection proper, namely, a methodical though unconscious selection by the insects. A most interesting question, and one well treated by Dr. Müller in his papers, is the following: "What peculiarities of flowers are to be attributed to insect-selection, and what to natural selection?"

When an anemophilous flower begins to become entomophilous, the first step is one tending to cause insects to come in contact with its stamens and pistil; and this is either the secretion of nectar in both forms of the unisexual flowers, or the union of the sexes to form a perfect flower. Adhesiveness of the pollen must also be developed in order to insure its transfer by insects from one flower to another. Nectar, being of great value to insects, and not directly useful to the plant, should be considered the result of insect-selection; but the adhesiveness of the pollen, being of immediate value to the plant, and only utilized in comparatively recent times by insects, should be considered as a result of natural selection. We must suppose that at first all flowers were equally accessible to all insects which chose to visit them. Through successive generations, however, the selective action of insects joined to natural selection wrought great changes, whereby the flowers were so modified as to adapt them to the visits of special groups of insects, which themselves experienced, by natural selection, changes fitting them to profitably visit the modified flowers.

Dr. Müller sums up the entire matter as follows: 1. All wild flowers are the result of the combined action of two different sorts of selection. Those peculiarities (such as attractive colors, odor, sheltered retreats, food, and the means of protecting this latter product against unbidden guests) which are immediately useful only to the insects which visit the flowers, are usually the result of the selection exercised by these insects themselves; but such peculiarities as are immediately useful only to the plant (the securing of crossing when insects visit the flowers, and of self-fertilization when they do not, and the protection of the reproductive organs against inclement weather and enemies) have been developed by natural selection, acting quite independently of the insects; finally those which are equally useful to both flowers and insects are the result of the combined action of both sorts of selection.

2. The first flowers were, for the most part, simple, regular and open, and were subjected to a mixed company of insect visitors, which succeeded in rendering permanent only conspicuous colors, odor, and nectar.

3. From this original mixed group, the carrion-loving Diptera,

with their tastes so different from those of other flower-frequenting insects, have become separated as independent selectors of flowers; and, through structural peculiarities enabling them to utilize certain modifications of the flowers, the butterflies, ichneumon flies, mining-wasps, wasps, bees, and syrphus-flies have likewise become separated.

4. The carrion-loving Diptera have bred flowers distasteful to other insects (Ekelblumen). Natural selection, coming to their aid, has produced various contrivances for securing cross-fertilization, such as kettle-traps (Kesselfallen) (*Aristolochia clematidis, &c.*), pinching-traps (Klemmenfallen) (*Asclepias, Pinguicula alpina, &c.*) and deceptive-flowers (Täuschblumen) (*Ophrys muscifera.*)

5. Longer tongued, more intelligent, and more dexterous insects have gradually been developed from those remaining, which differed from the Diptera, but agreed among themselves in their tastes. These insects have selected nectar, which less intelligent or shorter tongued insects could not find or reach, and also receptacles and shelter for the nectar, and marks guiding to it.

6. From this circle the butterflies were adapted by their slender tongues, and certain moths by their long tongues, to appear as independent selectors of flowers. The former have selected to their present perfection those flowers which are characterized by the narrowness of the passage leading to their nectar; the latter, such as possess greatly elongated nectaries. These flowers may be divided according to their time of blooming and their color, into diurnal and nocturnal butterfly-flowers, and diurnal and nocturnal moth-flowers, while we may distinguish many transitional forms. The well-developed sense of smell of the moths is indicated by the spicy fragrance of the flowers selected by them; the well-developed color sense of the butterflies, by the beautiful colors of the products of their selection.

7. Ichneumon flies surpassed all other flower-visiting insects of their time in their acute powers of perception, and thus they were able to select for themselves inconspicuous flowers which had escaped the notice of other insects. But after the appearance of the mining-wasps and bees, the ichneumon flies could retain their flowers only in places little frequented by these insects.

8. The mining-wasps probably superseded the ichneumon-flies as flower selectors, and selected those whose nectar was accessible only by forcing open closely appressed parts, creeping boldly into a cavity, or some similar action, easy only to insects accustomed to burrowing, or creeping into crevices. Later, however, bees came into partial possession of these flowers, and they further modified many of them.

9. Wasps were able by the power of their sting to secure sole possession of certain flowers which contained nectar and still remained open. These they selected in conformity with their

wants and tastes; but in places where wasps are not very abundant the products of their selection are shared by other insects.

10. As the most industrious and most skillful insects, and withal those most dependent upon flowers for food, bees have played the most prominent part in selecting flowers—at least in Germany. They have given us the most numerous, most diversified and most specially elaborated flowers, the visiting of which calls into play those faculties which the bees have acquired and inherited through their labors in caring for their young.

11. Finally, certain syrphus-flies, passionately fond of color, and themselves brightly colored, but not especially dependent upon flowers for food, have succeeded in producing certain flowers corresponding to their tastes; meantime natural selection has given rise to contrivances in these flowers which secure cross-fertilization through the instrumentality of these insects.—*Wm. Trelease.*

BOTANICAL NEWS.—In the February and March numbers of the *Botanical Gazette*, Mr. A. H. Curtiss begins a series of papers on the Botany of the Shell Islands of Florida. Mr. A. P. Morgan writes in the February number on the the phyllotaxis of leaves. Mr. C. R. Barns indicates the differences between *Heliopsis* and *Helianthus*, and Mr. C. H. Peck describes eight new species of fungi. In the March number Mr. A. M. Canby contributes some interesting notes on *Baptisia*, with a synopsis of American species.

Trimen's *Journal of Botany* for February contains an interesting biographical notice of Elias Fries, by A. N. Lundström, accompanied by a portrait. The ferns of Borneo are enumerated and a number of new species described by J. G. Baker. Jacob Bigelow, the author of the "Plants of the Vicinity of Boston," a book thumbed so much by botanical students twenty years ago, and which gave such a gentle and healthful stimulus to the walks of local botanists, died recently in Boston at an advanced age. Bigelow and other botanists owed much to the zeal and activity of Dr. J. W. Robbins, of Uxbridge, Mass., who died at about the same time.

ZOÖLOGY.[1]

THE OVIPOSITION OF THE QUEEN BEE AND DZIERZON'S THEORY. —According to a classical theory which had its birth in Germany, and which no one now-a-days disputes, a fecundated egg of the queen bee is a female egg, and all unfecundated eggs are male. The mother bee, it is said, can even lay at will an egg of one or the other sex. This faculty, which is exceptional in the animal kingdom, is explained by assuming that the bee, at the moment of the passage of the egg into the oviduct, can apply to it or not

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

a certain quantity of the seminal fluid contained in the seminal receptacle. Nevertheless the organization of the generative apparatus of the bee does not differ essentially from that of the majority of female insects, to which no one has ever thought of ascribing the power of acting at pleasure upon phenomena which seem to be absolutely removed from the influence of the will.

The hypothesis was set up mainly to explain the fact, which has hitherto not been disputed, that an Italian female fecundated by a German male furnishes hybrid females (workers and queens) and pure Italian males. The opposite would be the case if a German queen were fecundated by an Italian male; so that a male egg would never receive the seminal baptism, a drone would never have a father.

Now I possess at this moment a hive, the queen of which, the daughter of an Italian of pure race, has been fecundated by a French male. The workers in fact, are partly true Italians, others French, whilst others present a mixture in various proportions of the characters of the two races.

Being surprised to see in this hive certain drones amongst others as dark as French males, when according to the theory all ought to have been Italians, like their mother, I thought it necessary to examine these males more closely. I therefore collected three hundred of them and examined them most carefully, obtaining the following statistics: 151 were pure Italians, 66 were hybrids in different degrees, and 83 were French. From this it is evident that the drone eggs, like those of the females, receive the contact of the semen deposited by the male in the female organs; and the theory of Dzierzon, proposed to explain an insufficiently-ascertained fact, becomes useless if this fact is disproved.

It is easy to understand how an insufficient observation may have led to the belief that the drones, the sons of an Italian mother fecundated by a male of a different race, were all Italians. Of 300 males only 83 appeared to me to be strictly French, while 151 + 66 or 217, *i. e.*, the great majority, being yellower than the French drones, might easily pass for pure Italians. Thus, in such cases, if a great number of males in a hybrid hive have not been carefully examined one by one, it is easy to understand how it might be believed that they all belonged to the same race as their mother, especially when the latter belongs to the handsomer and yellower race.—*Comptes Rendus, Sept. 9, 1878, p. 408.*

Merrill's Ornithology of Southern Texas.—These notes comprise a list of birds observed in the vicinity of Fort Brown, Texas, from Feb., 1876, to June, 1878. The brochure is extracted from the Proceedings of the United States National Museum, and is valuable for the many field notes regarding the breeding habits of a number of the birds mentioned, with annotations by Dr. Brewer and Mr. Ridgway. Three plates of outlines add to the

value of the article. Twelve species of birds are enumerated which cross the Mexican border, and are thus new to our avifauna.

An Insect Borer in Powder Barrels.—We have received specimens of a Callidium (probably *C. variabile*), the larva of which have been found by Capt. McGinnis, U.S.A., to injure the hickory hoops of the powder barrels of the St. Louis Powder Depot. So injurious has this gnat proved that no inconsiderable sum is now annually spent in re-coopering barrels in order to make good the injury thus done. Means have been taken to prevent the ravages of the insects.

A Large Saw-fish.—In a communication from Samuel A. Shields, Jr., we are informed that the saw-fish (*Pristis*) which was caught in Grassy sound, opposite Five-mile beach, and about seven miles from Cape May city, measured sixteen feet in length, and six feet from tip to tip of the pectorals fins; its weight when caught was seven hundred pounds. The "saw" was four feet in length with twenty-four teeth on one side and twenty-five on the other.

Wrens and the Bee Moth. — My bees have at times suffered a little from the ravages of the moth. But in some seasons I have had several pairs of wrens nesting in boxes suspended from trees near my apiary, and I have noticed that during these years the moths are always scarce and but seldom seen. While my observation has not been accurate and systematic enough to enable me to say positively that the little birds, by catching the winged insects, prevented them from depositing their eggs in the hives, and thus saved the bees from the destructive ravages of the worms, I have always belived they were entitled to the fullest credit in that direction. I am so confident of their good offices, that I shall try and provide all that come to my premises with nesting-boxes, though I am well aware that the best possible protection is to keep the colonies of bees in the strongest possible condition. But I wish to give my feathered friends the amplest credit for all the good they do, and render all of the social kinds every assistance in my power.—*Chas. Aldrich, Webster city, Iowa*, 1878.

An Owl's Revenge.—In a village of the canton of Vaud, the inhabitants of a comfortable dwelling house discovered, last April, that a family of owls had taken up their abode under the same roof with them. There was a hole in the wall of the gable end about twenty feet from the ground, and in it these birds had made their nest. It was the first year that they had built in that place.

A young farmer and three or four of his friends who had frequently observed the owls entering and flying out of the cavity,

resolved to examine the nest. One Sunday in May, toward the close of the afternoon, they placed a ladder against the wall, whereupon the old birds flew out, and our young observers, going in turn to the summit, were able to gratify their curiosity by inspecting the family of owls. They found several young ones of extraordinary ugliness, and, according to their own account, after examining them they carefully replaced them in the nest. The parent birds did not that evening appear to be angered at the proceeding.

The next night, however, between 9 and 10 o'clock, as the young farmer was returning home followed by his servant-man some six or seven paces in the rear, on passing by the wall in question he heard a sound of wings and a violent exclamation at the same time from the servant. The latter, in evident pain and alarm, held his hands clasped over his right eye. He stated that the owl had flown suddenly down upon him, had driven her talons into his chin and then struck him upon the right eye with her beak. The blow, fortunately, did not fall on the eye-ball, and was not followed by any mutilation. Upon examination there were to be seen, besides a violent bruise below the eye, two bleeding wounds on the chin, the unmistakable imprint of the talons of the bird of night.

The man could not sleep during the night, partly from pain, partly from the necessity of applying cooling lotions to the injured part; he had plenty of time, therefore, to meditate upon vengeance, and the destruction of the nest was determined upon. But the next morning, about 5 o'clock, a cousin of the farmer passing by found the young owls on the ground at the foot of the wall. Unaware of the attack of the evening before, he gathered them up and with the aid of the ladder replaced them in their nest. Had some one taken these little creatures out? Had they fallen down? or, had the parents ruthlessly expelled them from the nest, no longer enduring them since human eyes had seen them in all their repulsiveness? To this no one can reply. It sometimes happens that a man fired with revenge, steals, knife in hand, behind his victim, strikes the fatal blow, and then discovers that he has mistaken the person. Such an incident occurred in Morges not long since. Was this the case with the owl? Were the young ones in fact taken from the nest the succeeding evening, and did the mother's vengeful beak merely strike the wrong person? It is impossible to decide this. The servant swore by all his Saints that he had not meddled with the nest, and that at the moment when he was attacked he was as innocent as a new-born child.

The next day witnessed a new act in the little drama. The owl, guilty both of malice and of a blunder, was speedily tried, condemned, and the suppression of the entire brood included in the sentence. Execution followed in the afternoon. The owls

were absent or had fled at the raising of the ladder, but the nest was destroyed and the young ones killed. Immediately afterward the parent-birds returned, exhibited the liveliest agitation, and flew backward and forward between the roof and a neighboring tree, snapping their beaks and uttering continual cries. The death of the old birds was also decreed, and for an hour or more the young man and his friends made vain attempts to shoot them. They were provided with an excellent gun, but the movement of the birds was so rapid that all their efforts were unavailing. Twilight came on, and still the owls pertinaciously hovered in the neighborhood of their ruined home. The friends becoming impatient went away, and the increasing darkness at length compelled the young man to give up his purpose. Just then the female owl flew into the dense foliage of a tree; into this the sportsman was about to fire at hazard when he suddenly heard a violent rustling of wings and leaves; the bird shot like an arrow across the thirty or forty feet of interval, M. F. received a fierce blow full on the left eye, and at the same time was conscious of the rapid apparition of two round flaming eyes close to his face. The shock and the pain were so violent that M. F. fell backward on the ground. The owls flew away, and only reappeared at long intervals during the ensuing days. The next morning after a night of suffering, the two wounded men arrived at Lausanne, the master in a car, with a bandage over his left eye, and the servant driving, with a bandage over his right. The injuries were as follows: the man presented a severe contusion of the tissues around the lower border of the eye, extensive swelling and infiltration of blood in the eyelids and under the conjunctiva. Ten or twelve days of cold applications removed all traces of the attack.

M. F., on the other hand, was seriously injured. An L-shaped wound had laid open the cornea, through the edges of which projected two fragments of the iris. The anterior chamber was obliterated, the crystalline lens crushed, and the tissues generally infiltrated from the hemorrhage. The patient could scarcely perceive the strongest light, and his sufferings were so acute that for some days injections of morphia were continually required.

(The details of the treatment of the case will not interest the readers of the NATURALIST, suffice it to say that after four weeks of suffering, during which iridectomy was performed, M. F. recovered a partial degree of sight in the injured organ, though Dr. Dufour is of the opinion that the eyeball will ultimately become atrophied.)

From this recital two conclusions may be fairly drawn:

1. That the owl is courageous enough not to fear attacking a man.

2. That when thus attacking, its blows are directed only at the eye. This intention, or these tactics, as it may be termed, was clearly shown in the two occurrences related.

It was not possible to ascertain exactly to what species these owls belonged. The adult birds could be neither captured nor killed, although, as may be supposed, after the second attack a price was set on their heads. All was without avail, they withdrew from the neighborhood, and were only seen again at long intervals.—*Translated by Dr. R. Fletcher from the Bulletin de la Société Médicale de la Suisse Romande.*

ANTHROPOLOGY.[1]

THE INTERNATIONAL CONGRESS OF ANTHROPOLOGICAL SCIENCES HELD IN CONNECTION WITH THE UNIVERSAL EXPOSITION AT PARIS, AUGUST 16–21, 1878.—*First Day.*—Opening address of the President, Dr. Paul Broca. Report upon anthropological societies and instructions in anthropology, by Dr. Thulie. Report upon anatomical, biological, and pathological anthropology, by Dr. Paul Topinard. Report upon ethnology of Europe, of Western Asia, and America, by M. Girard de Rialle. Report upon the ethnology of Eastern Asia, Africa, and Oceanica, by Dr. Bordier. First report palæoethnology—geological times, by M. Gabriel de Mortellett. Second report upon palæoethnology—neolithic period, or that of polished stone, by M. Emile Cartailhac Report upon Demography in relation to Anthropology, by Dr. Chervin.

Second Session.—Physical development of the two sexes in Italy, by M. Pagliani. Relations of the conformation of the skull with intelligence, by M. Le Bon. Notes upon the East Indians transported into Guiana, by Dr. Maurel. Notes on the hair, by Dr. Latteux. Relations of the proportions of the skull with those of the body, by Madame Clemence Royer. New dolmens in Portugal, by M. Da Silva.

Third Session—Anthropological mensurations, by Professor Stieda. The legend of the *Nuttons*, and the origin or cause of its expansion, by M. Edossard Dupont. Anthropological and ethnographical notes on Central Asia, by M. de Ujfaloy. Anthropometry, by Dr. Paul Topinard. Nineteen brains of criminals, by M. Benedict. A Tumulus on the banks of the Parana, Buenos Ayres, by M. Estasnilas Ceballo. Upon the arrival of the Bohemians in Europe, by M. Bataillard.

Fourth Session.—The ancient Guanches, by Dr. Chil y Naranjo. Creation of laboratories in the colonies of different States, by Prof. Virchow. Incised bones of cetaceans of the tertiary epoch, by Professor Capellini. The flaked flints of St. Acheul, by M. d'Acy. A cemetery of the epoch of bronze at Pogues (Nièvre), by M. Jacquinot. Digging in the grotto of the Mammoth, Poland, Count Zawisha.

Fifth Session.—The ancient monuments on the banks of the Vistula, by M. Zaborrowski. Homotypical characteristics of the thoracic and abdominal members, by M. Alexis Julien. Differen-

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

tial characters of the inferior and superior races of men, by M. Abel Hovelacque. An indication of ante-Columbian relations between America and Europe, by M. G. de Mortillet. Monograph upon the grottoes of human origin in the neighborhood of Brives, Correze, by E. Rupin and Ph. Lalande. The chipped flints from the north of Africa, and from the Orient, by Abbe Richard. Presentation of the album of the first age of iron. and of a palæoethnological atlas of the Departments of France, by M. E. Chantre. Pre-historic man in the basin of La Plata river, by Fl. Ameghino.

The communication of M. de Mortillet, whom we have learned to regard with especial reverence, is certainly premature, to say the least. The St. Acheul axes, alleged to be pre-glacial and intraglacial, are found by the hundreds on the surface all along our eastern rivers. It is to be hoped that the patriarch of archæology will suspend his judgment until the facts are more fully in hand.

The paper of M. Ameghino is very interesting and is well reported in the seventh and eighth numbers of Materiaux, from which magnificent journal this account is taken.

THE FOLLOWING IS A LIST OF SOME ANTHROPOLOGICAL CATALOGUES OF THE PARIS EXPOSITION, 1878.—Catalogue de l'Exposition des sciences Anthropologiques. Supplement au Catalogue des produits de l'Autriche. Vienne, Juin, 1878. 40 pp., 8vo.

Dr. G. C. M. Birdwood, Exposition Universelle. Manuel de la section des Indes Britanniques. Londres et Paris. 144 pp., 8vo., 5 pl. 1 ft. 25.

Catalogue raisonné des Antiquités du nord firmo-ougrien exposeés par l'Université Alexandrine d'Helsingfors a l'Exposition Universelle de 1878. 36 pp., 8vo., avec gravures.

Catalogue des crânes d'origine finnoise exposés par le musee d'anatomie de l'Université Imperiale d'Alexandre, en Finlande, a l'exposition des sciences anthropologiques. 20 pp., 8vo., une carte.

España: Catalogos de las secciones de ciencias anthropologicas y de arte retrospectivo. Madrid, 1878. 56 pp., 8vo.

Catalogue special de la section anthropologique et paleontologique de la Républiquc Argentine. 80 pp., lithog., Paris.

Exposition Universelle de Paris. Exposition ethnographique du musée d' ethnographie Scandinave à Stockholm, représenté par le Dr. Arthur Hazelius, fondateur et directeur du musée. 8 pp., 8vo.

Catalogue des objets envoyés à l'Exposition. Universelle de Paris, en 1878, par les exposants du departement de la Savoie. Chamberry, 1878; p. 302–355 consacrées a l'exposition anthropologique.

Philbert Breban: Livret-guide du visiteur à l'exposition historique du Trocadero, Paris, Dentu. 1 fr.

Tarameli Torquato: Note succincte sur l'Atlas de l'Orographie

des Alpes orientalis dans les periods tertiaire et postertiaire, essai de géologie continentale exposé aux sciences anthropologiques; Trocadero, Pavie, 1878. 12 pp., 8vo.

A. Mariette Bey: La galerie de l'Egypte ancienne a l'exposition retrospective du Trocadero. Description sommaire, Paris, 1878. 126 pp., 8vo.

Chauvet et Liévre: Les tumulus de la Boixe. Angoulême, 1878. 44 pp., 6 pl.

G. Chauvet: Notes sur la période neolithique dans la Charente. Angoulême, 1878, 25 pp., 3 pl.

Rules for the organization, in 1879, of an Anthropological Exposition of the Imperial Society of the Friends of the Natural Sciences, of Anthropology and Ethnology attached to the University of Moscow (confirmed by order of the government, May 20, 1878). We extract certain paragraphs of the circular, as being of general interest.

I. In order to familiarize the public with the questions of anthropology, principally respecting Russia, and to found at Moscow an anthropological museum as complete as possible, an anthropological exposition will be organized at Moscow during the summer of 1879.

II. The exposition shall be composed of objects having relation: 1. To the anthropological study of races which inhabit Russia. 2. To ante-historic races of that country (pre-historic archæology). 3. To general anthropology and to the systematic classification of races.

III. The objects admitted to the Exposition may be classed as follows:

1. Works concerning the anthropology and ethnology of Russia, and pre-historic archæology.
2. Charts of the distribution of races, and pre-historic monuments.
3. Photographs of types of different races, views of characteristic localities for the study of their customs, photographs and designs of costumes, utensils, habitations, and scenes displaying the manners of primitive peoples.
4. Busts and lay figures of different types.
5. Models of habitations and of costumes of primitive peoples.
6. Objects of domestic use, or having relation to the beliefs and the industry of the lower races.
7. Statistical tables of births, deaths, &c.
8. Models of tumuli (*Kourganes*) and of tombs.
9. Objects taken from ancient tombs, or pertaining to the pre-historic epoch.
10. Charts of geological sections and important localities for the study of ante-historic man; plans, models and designs of caverns.

11. Specimens of minerals which have served as material for ante-historic and primitive man for the fabrication of tools, and charts of their distribution.
12. Specimens of fossil and extant plants which are important in the study of the conditions of existence as affecting primitive races.
13. Remains of characteristic animals, or such as are related to the conditions of existence among the lower races. Skeletons and anatomical models of existing animals necessary to the comparative study of fossils.
14. Apparatus of anthropological research.
15. Anatomical models for the comparative study of races, necessary for instruction and the study of general anthropological questions.
16. Chemico-technical investigations upon objects of pre-historic archæology.
17. Elementary manuals designed to impart knowledge concerning the races of men, used in the courses of history and geography of the primary and secondary schools.

ANTHROPOLOGICAL NEWS.—Robert Clarke & Co., of Cincinnati, have issued a pamphlet of 75 pages, by Judge M. F. Force, containing two papers, the first of which is entitled, "Some Early Notices of the Indians of Ohio," the second, "To what Race did the Mound-builders belong." In the latter half of the seventeenth century, after the destruction of the Eries by the Five Nations, in 1656, what is now the State of Ohio was uninhabited. In the next half century, the first half of the eighteenth, various tribes pressed into Ohio. The Wyandots, or Hurons, extended their settlements into the North-western portion of Ohio and became permanently fixed there. Shawnees settled the Scioto Valley, Delawares moved to the valley of the Muskingum. Little detachments of the Five Nations, mostly Senecas, occupied part of the northern and eastern borders. The band of Senecas who settled between the Muskingum and the Pennsylvania border were called Mingoes. Parties of Cherokees often penetrated north of the Ohio, between 1700 and 1750, and later a party of them settled among the Wyandots, in the neighborhood of Sandusky. The history of the Eries and the Shawnees occupies the most of the first paper. and is well fortified by references to the original authorities from which the author has drawn. The paper upon the Mound-builders was read before the Congrès International des Americanistes, at Luxembourg, September, 1877. The conclusions to which the author arrives, are as follows: "The present state of information, therefore, leads to the conclusion that the Mound-builders were tribes of American Indians of the same race with the tribes now living; that they reached a stage of advancement about equal to that of the Pueblo Indians; that they were flourishing about a thousand years ago, and earlier and later; and

that at least in the tribes near the Gulf of Mexico were preserved some of their customs and some of their lineage, all after the discovery of America."

On page 56, mention is made of trees on the mounds, six hundred years old, and this remark follows: "Some of the works, therefore, must have been abandoned six or eight hundred years ago. It is quite possible that they were abandoned earlier, for these surviving trees may not have been the first to spring up on the abandonment of the work."

It is well to bear in mind the following facts before basing a chronological deduction upon trees: 1. The outer rings of a stump are very much narrower than the inner rings. If a section of the outer part of a stump decayed in the centre be counted, and the number of rings be multiplied by the ratio of the thickness of this section to the radius, it will give the age of the tree far greater than it really was. A ratio of increment could easily be obtained by examining a large number of stumps. Will not some one make the calculation for us? 2. Although the ground from which oak forests are cut, springs up thickly with pines, yet any one, by walking through these pines, will find here and there oaks which in the long struggle for existence will overtop the growth which now conceals them. 3. What evidence have we, that trees, especially nut-bearing trees, were not allowed to grow upon these works by the Mound-builders while they were still in possession of them? If this be true, all we can say is, that the mound or work was constructed (not abandoned) so many years ago.

These slight queries must not be allowed to detract from the value of Judge Force's highly meritorious work, especially with reference to the Eries and Shawnees, the latter of whom seems to have been the Gypsies of North America.

Mr. J. D. Putnam, Secretary of the Davenport Academy, sends us photographs of two mound pipes, one of them representing an animal like a bear, the other (mirabile dictu!) an elephant. The former creates no surprise; the latter is so like an elephant in body, limbs, head, trunk, all but tusks, that we have no hesitation in saying that the maker of it had seen an elephant, and tried to reproduce his likeness in this pipe. It was taken from a mound in Muscadine county, Iowa, and, so far as the integrity of the finder is concerned, is a genuine mound relic. It is impossible to state what the significance of this find may be: coupled with the discovery of an elephant mound in Grant county, in the adjoining State of Wisconsin, it seems to point to a former connection of the mammoth with man on our continent. By preserving the most scrupulous account of these ancient landmarks we may, in time, be able to explain their significance by further discoveries.

GEOLOGY AND PALÆONTOLOGY.

The Genus Cœlodon.—In the Vidensk. Selsk. Skr. v, 1887, Prof. J. G. Reinhardt gives the first full account of the genus *Cœlodon* of Lund, heretofore only described from a few fragments. The remains were all found by Lund in Brazil, and include, besides the fragments of the *C. maquinensis*, a skull and a good many bones of the skeleton of a second species which is described by Reinhardt as *C. escrivanensis*. The characters of the genus are very interesting, being near to *Megatherium*, although the species were not larger than the great ant-eater. The paper is well illustrated.

Dawson on Eozoön.—In the last number of the *Amer. Journ. of Science and Arts*, Prof. Dawson criticises the memoir of Möbius mentioned in the last number of the Naturalist. He thinks that Dr. Möbius has misinterpreted the evidence derived from his specimens. Thus he has mistaken the veins of chrysotile, which traverse the serpentine and calcite, for the walls of the *Eozoön* chambers. His objections to the unsymmetrical and irregular forms of the large so-called tubules, are met by the statement that these irregularities are due to pressure, faulting and other incidents of fossilization. The regular round and branching tubules, regarded as accidental by Möbius, are stated to be the normal structure by Dawson.

A New Genus of Perissodactyla.—In 1873 I described a species of ungulate, supposed to be related to the *Rhinoceridæ*, from the White river beds of Colorado, under the name of *Hyracodon quadriplicatus*. Further investigation shows that this animal represents a genus hitherto unknown, whose affinities are probably as much to the tapirs as to the rhinoceroses. The molars have the form and structure of those of *Lophiodon*, and the third and fourth premolars have the same characters as the true molars, which is not the case in that genus. The second premolar presents the elongate form characteristic of some species of *Anchitherium*. It has two cross-crests, and the external longitudinal crest presents three lobes besides the anterior and posterior prolongations, somewhat as in the corresponding deciduous tooth. I call this genus *Anchisodon:* the species *A. quadriplicatus* was as large as the *Aceratherium occidentale*. A second species has been found in the John Day region of Oregon, in the White river formation. Its molar teeth differ in the presence of a fossa which is isolated by the contact of the edges of two processes, one from the external crest, the other from the posterior cross-crest. The anterior cross-crest has no processes; there is a compressed tubercle at the entrance of the transverse valley, but no cingulum on the posterior base of the crown as in *A. quadriplicatus*. The fore and aft diameter of a middle molar is .028 m., the transverse .028. The anterior crest is strongly recurved, and the posterior notch

is profound. Enamel smooth. The species may be called *Anchisodon tubifer.—E. D. Cope.*

A NEW GENUS OF ICHTHYOPTERYGIA.—Prof. Marsh has recently described a genus which he does not distinguish from *Ichthyosaurus* excepting by the entire absence of teeth, and even of a dental groove. He names the genus *Sauranodon.* The only known species *S. natans* is from the marine Jurassic of the Rocky mountains, and is about nine feet in length. Prof. Marsh proposes to regard *Sauranodon* as the type of a new order, but the only reason he assigns for this course, the absence of teeth, is insufficient.

MUSCHELKALK FOSSILS IN IDAHO.—In the last number of the *Bulletin* of the Hayden Survey, Dr. A. C. Peale describes certain mesozoic strata of South-eastern Idaho, which contain both Jurassic and Triassic invertebrate fossils. The lowest of these contains Cephalopods described by Dr. White, which Mr. Hyatt regards as more nearly allied to the forms of the Muschelkalk, although they are associated with some Jurassic species, one of which is also doubtfully identified from the top of the section.

GEOGRAPHY AND TRAVELS.[1]

THE DUTCH ARCTIC EXPEDITION. — In the NATURALIST for August, 1878, mention was made of the sailing of the small schooner *Willem Barentz* from Ijmuiden, on the 5th of May, 1878, for the Arctic seas. This preliminary voyage was chiefly undertaken to give experience in ice navigation to officers and men, as well as to make scientific observations in the Barentz sea, between Spitzbergen and Novaya Zemlya, and is expected to be followed by a second and more important expedition. For an account of the experiences of this small company of fourteen souls, we are indebted chiefly to Mr. Clements R. Markham.[2]

After calling at the Norwegian port of Bergen, they set sail on the 18th of May for Jan Mayen, arriving in sight of this remote volcanic island on a fine day, June 9th. The view, so rarely enjoyed in this region of continual fog, was impressive. The island is thirty miles long and nine broad, and at the north end rises the remarkable volcanic peak, Beerenberg, 6300 feet in height, covered with snow almost to the water's edge, and presenting a most imposing appearance, the high jagged summits of the lower hills, from which smoke was slowly rising, appearing quite dwarfed in comparison.[3]

A storm arising prevented their landing, and on the 12th they

[1] Edited by ELLIS H. YARNALL, Philadelphia.

[2] *Proceedings Royal Geographical Society*, January, 1879.

[3] See *Illustrated London News* for October 26, 1878, for view of Jan Mayen from photograph taken on board of the *Willem Barentz*. Also number for January 25, 1879.

reached the edge of the west ice, and keeping along the line of this ice they reached the north-western end of Spitzbergen on the 19th. "Spitzbergen has justly earned its name, for one sees nothing but sharp-pointed rocks showing amongst the colossal glaciers, while the sun, throwing a red glow, brings the whiteness of the snow into startling contrast with the deep shadows." On the 27th they reached their furthest northern point in 80° 18′ N., off Verlegen Hock. After stopping at Amsterdam island to erect a memorial slab of granite in the midst of the graves of Dutch whalers who died there in 1633–5, and touching at Bear island they arrived at Vardö, in Norway, on the 22d of July, and then commenced the reconnaisance of the sea of Barentz, sailing north along the 45th meridian. Ice was again met on the 1st of August at 77° 10′ N., and after proceeding westward and attaining a point (lat. 77° 44′ N., long. 35° 30′ E.) eighty miles from Wyche island, they were driven to the south by heavy gales. To the eastward of longitude 38° the ice was found to be thin, level and rotten, while to the westward there were heavy floes of immense thickness with hummocks thirty feet high. In the beginning of August they appeared to be on the boundary line where the warm and cold currents meet. Up to that time they found that the temperature of the sea decreased with its depth; but here they met with cold and warm currents flowing one over the other. The explorers next proceeded to Novaya Zemlya, and proceeding northwards along the coast to Cape Nassau, steered to the north-west and found the ice-field on September 7th in 78° 17′ and 55° 14′ E. From here the *Willem Barentz* made her way to Hammerfest, and this successful trip was finally ended at Amsterdam on the 13th of October. Experience of the ice movements between Spitzbergen and Novaya Zemlya had been acquired, a full hourly series of meteorological observations had been taken as well as deep sea soundings and magnetic observations and very valuable collections in natural history made. Notwithstanding almost constant fogs an excellent series of photographs was completed.

THE NORWEGIAN NORTH ATLANTIC EXPEDITION.—During the past three summers a Norwegian expedition under the charge of Dr. Mohn, Dr. Sars and other scientific men has been exploring the sea between Norway, the Ferroe islands, Iceland and Spitzbergen. Being well supplied with the most recent inventions for dredging, sounding, obtaining sea temperatures, etc., the scientific results are stated to be very satisfactory. Their investigations have now been concluded. The three summers have yielded in all 375 sounding stations, 113 temperature series, 44 dredgings and 42 trawlings. It was ascertained that during June and July the minimum temperature of the water off the coast of Norway is neither at the bottom nor at the surface, but at some intermediate strata of considerable depth. The explanation offered is

that in winter the cold water of the surface descends on account of its increased weight, until it reaches a stratum where the superincumbent water causes by pressure an equal density. In the warm months the surface water becoming heated has no tendency to sink. The warm Atlantic current was traced to the north of the eightieth degree of latitude along the west coast of Spitzbergen.

GEOGRAPHICAL NEWS.—The parties under Lieut. G. M. Wheeler, Corps of Engineers, continued their work during the season of 1878, in California, Colorado, Nevada, Oregon, Texas, New Mexico, Utah and Washington Territory, and surveyed approximatively 35,000 square miles, commencing July 1st and ending December 25th. Lieut. Wheeler was with party No. 1, California section, in the region north of a line joining Fort Klamath, Oregon, and Camp Bidwell, California, northward to the Columbia river. Prof. Stevenson, geologist, and his assistant, Mr. Russell, investigated the coal fields of Colorado and eastern New Mexico, and Mr. Henshaw continued to increase his zoölogical collections in California and Oregon.

Recent geographical publications in Germany include: Aus Mexico, Reiseskizzen aus der Jahren 1874 und 1875, von Dr. Fr. Ratzel; Reise durch den Stillen Ocean, von Max Buchner; Die Sahara, oder von Oase zu Oase, Bilder aus den Natur und Volksleben in der grossen afrikanischen Wüste, von Dr. Josef Chavanne; Die Literatur über die Polar Regionen der Erde, von Dr. Josef Chavanne; Abriss der praktischen Astronomie, vorzüglich in ihrer Anwendung auf geographische Ortsbestimmung, von Dr. A. Sawitsch nach der zweiten russischen Original Ausgabe; Ethiopien-Studien über West-Afrika, von Dr. W. Hübbe-Schleiden, and Beiträge zur physischer Geographie der Mittelmeerländer besonders Siciliens, von Theobald Fischer.

Dr. Edwin R. Heath, of Wisconsin, sailed from New York November 18, 1878, for Para. He expects to explore the Beni and Madre di Dios rivers of Brazil. He has already spent some years in South America and is well prepared for the difficult work he has undertaken.

The newly colonized "northern territory" of South Australia is not the desert it was recently thought to be. The appearance of the natives is very gaunt and peculiar, their black faces being painted across with bands of white, so that they have a death's-head like appearance. It is stated that they cut off a joint from the finger of a mother for every child of hers that dies. As they also kill their weakly or delicate children, this practice is likely often to be of considerable inconvenience.—London *Times*.

The Russian government survey for a railway between Orenburg and Tashkend is finished and shows that it is quite possible to carry the line through the desert of Kara-Kum. An exploration will be made in 1879 towards Samarcand and in the direc-

tion of Cabul and Peshawur. Col. Prejevalsky will shortly set out on his new exploring expedition to Kuldja, Thibet and the Himalayas.

The last supplement to *Petermann's Mittheilungen* is devoted to an elaborate monograph by Dr. G. A. Credner, of Halle University, upon deltas. The paper is divided into two sections. In the first he treats of the limits of deltas, their character, and formation of their surface, their size, power, material, rate and results of growth, their age, number and geographical distribution and classification. In the second he treats of the origin and causes of the formation of deltas, and the geological problem thus presented. Maps showing the various deltas and illustrating the upheaval and subsidence of land are also given.

The British Arctic exploring ship *Alert* has again been put into commission under her old captain, Sir George Nares, for surveying service in Magellan's straits and the south Pacific. The work in Magellan's straits is expected to occupy from one to two years. The *Alert* will then proceed to make isolated but important surveys in the neighborhood of the Society, Friendly and Fiji islands and of shoals and reefs between the Fijis and New Zealand, and finally on the south-western and north-western coasts of Australia.

Major Herbert Wood and other writers have heretofore confidently asserted that the ancient river Oxus (now the Amu Darya) has within historic times emptied into the Caspian sea, and that its ancient channel can still be traced. The recent breaking down of a dam at Fort Bend on the Amu, which has caused a deviation of its waters in the direction of this old bed, has originated the report mentioned in the London *Times* that the river was about to resume its former course. Prof. Kiepert now writes to the Berlin *National Zeitung* to deny this report. He asserts that the old bed of the Oxus belongs to geology and not to history and that the project of completely restoring the ancient water-course and opening a new water way from Moscow to the heart of Asia is one which would overtask the resources of the richest state.

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SCIENTIFIC NEWS.

— In December, 1878, Dr. Gustav Leonhard, of Heidelberg, died, leaving the editorial management of the Jahrbuch für Mineralogie, so long and favorably know in America, in the hands of Dr. Hans Bruno Geinitz, of Dresden. Now, after sixteen years association with Dr. Leonhard, Dr. Geinitz retires from the editorship. The dissolution of this distinguished partnership will create a new feature in geological literature, and we can only wish Dr. Geinitz the same success in the cultivation of his favorite science in the future that he has had in the past.

— We regret to learn that in the great press of business which occupied the last hours of the late National Congress, the amendment to the Legislative, etc., Appropriation Bill, abolishing the existing Geological Surveys of the Territories, was passed. The fact that this measure had been defeated in the Committee on the Whole, and also in the House by votes of two to one, did not prevent its passage in consequence of a transfer at the last moment to the Sundry Civil Bill. A large number of scientific men will now have opportunity to repent at leisure their apathy in having allowed the substitution of one organization in place of three or four, which will, in all probability, not receive from Congress even the third of the aid which the surveys have been accustomed to obtain. The only remedy is to give the direction of the new Bureau to the man who has shown himself most influential in impressing Congress with the importance of making large appropriations for scientific work. The plausible plea that the geological surveys have been misused for the prosecution of zoological and other work, however it may affect the Executive, will not receive much sympathy from men of science. It is not true that a generous sympathy with all branches of science unfits a man for the directorship of a scientific survey.

— With much regret we have to announce the death of the distinguished palæontologist and comparative anatomist, Paul Gervais, which took place on February the 10th, in Paris. Prof. Gervais was born at Paris, on September 26, 1816. After taking the degree of doctor in science and medicine, he served as one of the aide-naturalistes of the Muséum d'Histoire Naturelle. In 1841 he became professor of zoölogy to the Faculté des Sciences of Montpellier; and on the death of Gratiolet, in 1865, he was appointed to the vacant professorial chair at the Muséum d'Histoire Naturelle, which he filled till his death. M. Gervais' powers and industry are attested by the value and number of his scientific papers, which in 1873 amounted to a hundred and sixty-four in number. In these he touched on almost every group of the animal kingdom; but his principal attention was directed to the higher classes, especially to the mammalia, recent and extinct. Of his separate works the most generally known are his Zoologie et Paléontologie Françaises, Zoologie et Paléontologie générales, Ostéographie des Monotrèmes, and (in collaboration with Prof. P. van Beneden) his Ostéographie des Cétacés; both of the last-named works are unfortunately left unfinished. He was principal editor of the Journal de Zoologie.

In 1873 M. Gervais was elected a member of the Académie des Sciences, and he was a foreign member of the geological and zoölogical societies of London.

Prof. Gervais was one of the few living authorities on the palæontology of the Vertebrata, and was engaged at the time of

his death on a work on the minute structure of the bone of the various groups of Vertebrata. He leaves a son who is an able anatomist.

— The Geological Society of London has awarded to Prof. E. D. Cope the Bigsby Gold Medal in recognition of his services to palæontology.

— It appears that the Legislature of Pennsylvania is in some danger of failing to make appropriation for the continuation of the Geological Survey. We very much regret the existence of such a possibility, and hope that our legislators will carefully consider the interests of their constituents in this matter. Nothing is more valuable to a commonwealth than an inventory of its actual possessions, with a knowledge of their distribution and the methods of making them available. A knowledge of the physical constitution of a region is also an essential in the educational system of its inhabitants. Neither of these ends can be accomplished without the Geological Survey made by experts in the science, and no class of public servants produces more valuable work for less money than they. By all means continue the survey.

— We have received the first number of the Guide du Naturaliste. Revue bibliographique des Sciences Naturelles, Bulletin mensuel. Par A. Bouvier. Paris, 1879. (Un franc le numéro.) This is a valuable and newsy monthly, giving full details of contents of the journals and proceedings of the scientific societies of France, with courses of lectures in botany, zoölogy and geology.

— An elaborate and fully illustrated essay, by Dr. Hermann Müller, on the Cross-fertilization of plants, extracted from Schenk's Handbuch der Botanik, has been received too late for careful review.

— Early in January about five million young codfish were turned into the sea by the assistants of the United States Fish Commissions stationed at Gloucester, Mass.

— At the annual meeting of the California Academy of Sciences, held Monday, Jan. 6th, the following officers for 1879 were elected: President, George Davidson; corresponding secretary, S. B. Christy; director of museum, W. G. W. Harford.

— The Marquess of Tweedale, better known as Viscount Walden, President of the Zoölogical Society of London, died Dec. 29th, 1878. He was an active ornithologist, paying especial attention to the birds of the East Indies.

— Victor Ghiliani, one of the founders of the Italian Entomological Society, died in May last at Turin. Dr. Wilhelm Engelmann, the eminent German publisher of scientific books died at Leipzig, December 23.

— Congress has passed a bill appropriating $250,000 for a fire-proof National Museum, adjoining the Smithsonian Institution.

— According to *Nature*, the widow of the late Prof. Eichwald has presented the remarkable palæontological collections of her husband to the St. Petersburg University. The collection contains upwards of 30,000 specimens of fossils, from the various formations of Western Europe, from the Petchora Land, from the Aleutians islands, Siberia, Crimea, etc.

— Vōgelbilder aus fernen Zonen, is the title of an atlas of foreign birds, just published by Fischer, of Cassel, under the care of Dr. Ant. Reichenow. It is noticed favorably by *Nature*.

— Fresh attention is drawn to the study of microscopic organisms by the appearance of part one, of the third volume of Stein's great work on Infusoria; as well as by a translation of Bütschli's essay on the Flagellate Infusoria (referring to H. James Clark's work done on American forms), and also by H. B. Brady's descriptions of deep sea Rhizopods in the *Quarterly Journal of Microscopical Science*.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, Dec. 9, 1878.—Prof. Henry Wurtz exhibited a large series of the minerals from the Silver Islet, Lake Superior, and described under the name of Huntilite (in honor of Prof. T. Sterry Hunt), a new species of silver ore from that locality. Huntilite occurs both massive and minutely crystallized, and is essentially an arsenide of silver, occupying the gap in mineralogy between dyscrasite and domeykite; dyad metals, especially nickel, appear to have replaced some part of the silver, and antimony a small part of the arsenic. Prof. Wurtz gave minute and laborious analyses and many interesting details.

Dec. 23d.—Mr. A. A. Julian made a communication on the glacial excavation of the Kaaterskill Clove. Mr. B. B. Chamberlin exhibited a series of minerals from the zinc and lead mines of Wisconsin.

Jan. 6, 1879.—Dr. Ephraim Cutter addressed the Academy on Tolles' one-seventy-fifth-inch objective—its history, construction and use (with sciopticon illustrations).

Jan. 13.—Prof. Henry Wurtz presented before the Chemical Section, further particulars of his new mineral, Huntilite, from the Silver Isles of Lake Superior.

Jan. 20th.—Mr. S. W. Ford read a paper on the structure and development of certain primordial trilobites. Mr. A. A. Julian remarked on the conglomerate from the sand-beds of Southeastern New Jersey. Dr. R. P. Stevens made a communication on the glacial moraine at Jamaica, Long Island.

Jan. 27th.—At a meeting of the section of Biology Dr. Charles

F. Taylor presented the results of some practical studies in Psycho-biology, with especial reference to the influence of mental states on disease.

March 3.—Mr. W. R. Gerard read a Note on the influence of sulphurous acid gas on coniferous trees.

AMERICAN GEOGRAPHICAL SOCIETY, Feb. 27.—Lieut. T. B. M. Mason, U.S.N., read a paper entitled the Preservation of life at sea.

March 11.—Gen. R. E. Colston lectured upon Life in the eastern and western deserts of Egypt and the Soudan, among the Bedouin tribes, with a description of their manners and customs, the waterless land, the mirage, the animals—especially the camel.

BOSTON SOCIETY OF NATURAL HISTORY, Feb. 19.—Mr. H. G. Kittredge read a paper on the Natural history of Cotton. Mr. L. S. Burbank made a communication on the Clay beds of ancient estuaries.

March 5.—Prof. W. G. Farlow read a paper on North American Characeæ, and Mr. W. O. Crosby spoke concerning a possible origin of petrosilicious rocks.

APPALACHIAN MOUNTAIN CLUB, March 12.—Mr. G. F. Hammett read a paper on the Practical application of mountain sketching, and Mr. W. O. Crosby spoke on the Pitch Lake of Trinidad.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

SIEBOLD AND KÖLLIKER'S ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE.—December 19, 1878. The sexual organs of Cephalopoda, by J. Brock. Sixth paper on the structure and development of sponges, by F. E. Schulze. Studies on the anatomy of breathing organs—I. On the anatomy of the gills of Serpula, by L. Löwe.

BULLETIN OF THE U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, Vol. v, No. 1.—Notes on the Aphididæ of the United States, with descriptions of species occurring west of the Mississippi, by C. V. Riley and J. Monell. The relations of the horizons of extinct vertebrata of Europe and North America, by E. D. Cope Observations on the faunæ of the Miocene Tertiaries of Oregon, by E. D. Cope. Notes on the birds of Fort Sisseton, Dakota Territory, by C. E. McChesney. Palæontological papers—No. 9. Fossils of the Jura-Trias of Southeastern Idaho, by C. A. White. Jura-Trias section of Southeastern Idaho and Western Wyoming, by A. C. Peale. Fossil forests of the volcanic Tertiary formations of the Yellowstone National Park, by W. H. Holmes. Palæontological papers—No. 10. Conditions of preservation of invertebrate fossils, by C. A. White. Supplement to the bibliography of North American invertebrate palæontology, by C. A. White and H. A. Nicholson.

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ON THE DESTRUCTIVE NATURE OF THE BORING SPONGE, WITH OBSERVATIONS ON ITS GEMMULES OR EGGS.

BY JOHN A. RYDER.

IN 1871 a vessel laden with marble was sunk in Long Island sound, and according to Prof. Verrill, the boring sponge has penetrated the exposed parts of the blocks for a depth of two to three inches from the surface. The canals or tunnels in a specimen of this marble which I have examined, vary from one-fourth to an hundredth of an inch and less in diameter; the canals are coated within with a thin film of dried sarcode of a brown color, which was orange-colored in life. Though the sarcode is dried, the needle-shaped spicules are plainly visible under a one-fifth inch lens, and display the form usually seen in the same species found on the coasts of Europe. The spicules, according to my measurements are $\frac{1}{83}$ of an inch long, agreeing exactly with the length given by Mr. H. J. Carter as observed in British specimens, and about $\frac{1}{10000}$ of an inch in diameter, and are, as is well known, siliceous. The specimen which I have seen, shows, in what appears to have been the inner portion of the block, a series of large branching canals which connect freely with each other in the most irregular way imaginable; moreover, the form of the canals in transverse section is exceedingly variable, being oval or irregular as often as it is circular. These last facts, together with that of the great variability in the calibre of the canals, leaves no doubt in my mind that it is the animal of the sponge which does the boring, and not marine worms which have politely abandoned their bur-

rows for the accommodation of this toiler of the sea. It is well known that this species and its allies are found filling systems of canals in the shells of many species of mollusks, both dead and alive, as well as in fragments of limestone, but it is probably rare to find it in such a vigorous condition of development as in the submerged cargo of marble referred to above. Mr. H. J. Carter believes that occasionally some of the parasitic species do not bore their habitation but develop freely in the same manner as ordinary non-parasitic forms. Bowerbank in his "Monograph of the British Spongidæ," mentions an affiliated species which is parasitic on a sea-weed, boring or dissolving away the soft parts and allowing the harder fibrous structures to remain as a means of support.

It may be well to bear in mind that these sponges, notwithstanding the fact that they excavate their own habitations, are not parasites in the sense in which nematoid and cestoid worms are parasitic, as Haeckel, with his usual sagacity, points out in his Monograph of the Calcareous Sponges.

Dr. O. Schmidt observes (Brehm's Thierleben), that, "A large portion of the coasts of the Mediterranean and Adriatic seas is composed of calcareous material which, from its tendency to become eroded, has a broken, jagged aspect, giving it a peculiar and often attractive appearance. Of such broken Dalmatian coast one can certainly measure off some thousands of miles of strand, and where it does not descend too abruptly, large and small stones and fragments of rocks cover the ground. One can scarcely pick up one of these billions of stones without finding it more or less perforated with holes and eroded by Cliona, often to such a degree that the spongy remains of the apparently solid stone may be crushed in the hand." The same writer farther observes: "This brings us finally to the question, by what means does this sponge eat its way into the rock? One would first think of the siliceous needles as the cause, but we soon see that we must abandon the notion that this is the boring apparatus, since it must be borne in mind that such apparatus must be operated. Even though the protoplasm executes delicate fluctuating movements, so that in *Cliona* (*Vioa*), as in many other sponges, the needles are drawn into bundles, rows or series in particular directions, in any case, the force so exerted would not be sufficient to scrape or erode the lime rock with their

points. The mode of distribution and extension of the sponge would rather indicate that a process of chemical solution was the real agent at work in erosion. Of the exact constitution of this corrosive fluid we, however, as yet know nothing. The importance of the boring sponge in helping to effect the redistribution of eternal matter, does not consist in comminuting the stone into particles, but in dissolving it as sugar is dissolved in a glass of water, and mingled with the sea-water in this dissolved condition. Out of this solution the innumerable shell-fish take the mineral materials which have been mingled with their blood, and from which it is deposited as new layers on the shell, which, when the animal dies, either is also finally redissolved by the sponge, or falls to the bottom of the sea as a contribution to the earth's strata of future æons."

Dr. Leidy[1] observes in regard to the agency of this organism in disintegrating the shells of dead mollusks, "that an extensive bed of oysters, which had been planted by Thos. Beasley at Great Egg harbor, and which was in excellent condition three years since (1857), had been subsequently destroyed by an accumulation of mud. The shells of the dead oysters, which were of large size and in great number, in the course of two years have been so completely riddled by the boring *Cliona*, that they may be crushed with the utmost ease, whereas without the agency of this sponge the dead shells might have remained in their soft muddy bed devoid of sand and pebbles, undecomposed perhaps even for a century." The ability of such an organism to comminute both organic and inorganic calcareous materials is well illustrated in the instance above cited, and their influence in modifying the character of marine deposits is clearly implied.

In a specimen of the common *Ostrea virginiana*, recently handed me for examination by my friend, Mr. John Ford, the substance of the shell was thoroughly cavernated so as to render it extremely brittle and readily crushed; in fact the inner table of the shell left standing showed a great number of elevations within, which indicated points where the intruding parasite had been kept out by the oyster which had deposited new layers of calcareous matter at these places so as to give rise to the elevations spoken of. Besides this, the inner table had become so weakened at the insertion of the adductor muscles that the animal

[1] Proc. Acad. Nat. Sciences, Phila., VIII, 162.

in closing had torn a part of it loose, which had been repaired by the deposition of a brown horny substance. Evidence of the presence of the boring sponge may very frequently be noticed in shells of oysters brought to the markets, though it often appears as if the parasite had left its work incomplete, being killed on its host. I find that Schmidt has also noted this, and that the boring operations of the sponge usually seem to stop in the case of living mollusks, at the nacreous layer.

Dr. Leidy (l. c.) gives a lucid account of the living sponge as found in *Ostrea virginiana* and *Venus mercenaria*. He says, "This boring sponge forms an extensive system of galleries between the outer and inner layers of the shells, protrudes through the perforations of the latter tubular processes, from one to two lines long, and one-half to three-fourths of a line wide. The tubes are of two kinds, the most numerous being cylindrical and expanded at the orifice in a corolla form, with their margin thin, translucent, entire, veined with more opaque lines, and with the throat bristling with siliceous spiculæ. The second kind of tubes are comparatively few, about as one is to thirty of the other, and are shorter, wider, not expanded at the orifice, and the throat unobstructed with spiculæ. Some of the second variety of tubes are constituted of a confluent pair, the throat of which bifurcates at bottom. Both kinds of the tubes are very slightly contractile, and under irritation may gradually assume the appearance of superficial wart-like eminences within the perforations of the shell occupied by the sponge. Water obtains access to the interior of the latter through the more numerous tubes, and is expelled in quite active currents from the wider tubes."

A point of considerable interest in this connection is Mr. W. J. Sollas'[1] discovery of the existence of membranous and spiculiferous diaphragms in some English species of these sponges. These diaphragms are composed of sarcode in which, in some instances, very short club-shaped spicules are imbedded, pretty densely packed together, with their opposite extremities lying at opposite surfaces of the diaphragm. In some cases the diaphragms are perforate, forming an annular band inside the canal and attached by an edge, the other edge being constricted somewhat, so that the bands sometimes have the form of hollow truncated cones. In other instances these partitions are membranous films contain-

[1] Am. Mag. Nat. Hist., 5th Series, Vol. 1, No. 1, 1878, p. 54.

ing spiculæ of the ordinary form; these also may be perforate or imperforate and conical. Their office is not yet understood, but it is suggested by their discoverer that they are for the purpose of interrupting or modifying the direction and flow of the currents of water created by the ciliated cells of the tissue lining the cavities of the organism.

In the examination of a second specimen kindly handed me by Mr. Ford, and which had been removed from its native brine only a few hours before, I was enabled to distinguish very plainly the ova or gemmules strewn through the orange-colored sarcode. These are bodies fully three times as large in diameter as the ordinary sponge cell, of an oval shape covered with a tough transparent rather thick membrane. The contents are transparent and granular with the exception of the nucleus, which is opaque and deep-orange in color and is often broken up into several apparently homogeneous granules of variable size; a part of these granules may occupy one extremity of the ovum, another part the other, or they may be placed eccentrically, or be arranged in a semicircle. The diversity in this respect is very great, so that but few are met with which are very nearly alike. These differences may represent various stages of development, but there seems to be a want of the orderly arrangement which would be expected if this were the case, besides, the wide separation of the nuclear bodies into two and even three parcels would not favor such a view.

I was quite unable to distinguish any flagellate cells in this specimen, even with a power of 1000 diameters, although there can be little doubt of their existence, as may be inferred from Prof. Leidy's account of the physiological actions of the organism. Mr. Carter, however, has figured these cells in a paper already referred to, and he observes that the flagelliform processes of the cells lining the canals of the fresh-water sponges are withdrawn into the sarcode body of the cell soon after being detached from the walls of the canals, which may have been the trouble in this case.

THE MESOZOIC SANDSTONE OF THE ATLANTIC SLOPE.

BY PERSIFOR FRAZER, JR.

THREE pamphlets lie on our table and constitute very important additions to the knowledge of the most puzzling of all geological formations, viz: that portion of the series lying between the Carboniferous and Cretaceous in this country. They are entitled as follows: "The Mesozoic Formation in Virginia, by Oswald J. Heinrich, Mining Engineer,"[1] "Notes on the Mesozoic of Virginia, by Wm. M. Fontaine,"[2] and "The Physical History of the Triassic Formation of New Jersey and the Connecticut valley, by Israel C. Russell."[3]

Without disparaging the merits of the other two, it must be said that the paper of Mr. Heinrich embraces more exact and positive knowledge of lasting value than either of the others. To complete the set, there should be added to the three just mentioned, a pamphlet of a few pages, by Persifor Frazer, Jr., on "The Position of the American New Red Sandstone" (read at the New York meeting of the A. I. M. E., Feb., 1877). In this paper there is a column of strata represented in a section across the Mesozoic belt from York to Dillsburg which will be of interest to those who have carefully read Mr. Heinrich's pages.

These contributions, taken together, are so valuable that a brief sketch of their separate contents will be of interest.

Frazer's Paper.—To take them in the order of their date, Frazer speculates upon the probable relationships of the various strata represented in his broad section with those of the European column, rather leaning to the belief that the rocks of Mesozoic age in Southern Pennsylvania, correspond with those which fill in the space occupied by the upper half of the lower Permian and the superior beds at least to the base of the Lias (*i. e.*, including the Rhætic beds). He says: "By this hypothesis the 'New Red' of York and Adams counties would reach from the middle portion of the lower half of the Dyas or Permian at least to the base of the Lias, including all the rocks attributed to the Trias and the beds below it, except the lower

[1] Read at the Phila. Meeting of the American Institute of Mining Engineers, Feb., 1878.

[2] American Journal of Science and Arts, Jan., 1879.

[3] From the Annals of the New York Academy of Sciences. 1878.

Rothliegendes of the German scale." The thickness calculated by him for Prof. Rogers' section below Yardleyville is 51,500 feet, or nine and three-quarters miles, on the assumption that the bedding is normal, but this is regarded as delusive; and in a subsequent paper, by the same author, on "Some Mesozoic Ores" (Am. Phil. Soc. Proc., April 20, 1877), the wave-strewing hypothesis, by means of which Prof. Rogers sought to explain the inclined bedding is rejected as insufficient to account for all the phenomena.

Mr. Heinrich's paper is rich in facts, and is as remarkable for the absence of speculations as it is for the clear and logical standpoint from which he views the whole subject. Like Prof. Fontaine, he commences by describing the divisions of the formation into belts, but whereas Mr. Heinrich groups all the known exhibitions of Mesozoic, in Virginia, into four belts, Prof. Fontaine disposes of them in six belts. This latter arrangement does not seem to be necessary by reason of the small gaps between the various members of Heinrich's belts, and presents to the student not on the ground, manifestly greater inconveniences.

It is evident that even Heinrich's number of divisions is arbitrary, since a prolongation of the "Eastern" belt crosses the "Middle Eastern" at Taylorsville and joins the "Middle Western at Mount Vernon," but these separate ranges and the lines indicating them on his map, greatly assist the understanding of his minute details. His belts here follow.

A *Eastern.*—Includes (1) the Petersburg deposits, and (2) the scattered masses of Mesozoic in Greenville and Brunswick counties, west of Hicksford and east of Lawrenceville.

B *Middle Eastern.*—(1) Taylorsville deposits, (2) Springfield deposits, (3) Richmond deposits.

C *Middle Western.*—(1) Aquia deposits, (2) Farmville deposits, from Mount Vernon to Fredericksburg.

D *Western.*—(1) Potomac deposits, running from the Potomac river near Point of Rocks to the Wilderness, (2) Barboursville deposits, (3) James River deposits (near Scottsville), (4) Danville deposits, (5) Dan River deposits, on and south of the N. Carolina line.

Prof. Fontaine calls D 1 his "*New Jersey*" belt, D 3 his *Buckingham* belt, D 4 the *Pittsylvania* belt, C 2 (or a part of them) the *Prince Edward* belt, B 3 and a part of A 1 the *Richmond* belt, the southern portion of A 1 the *Petersburg* belt, which Prof. Fontaine describes as overlapping the Hanover area (*i. e.*, the

northern part of the *Richmond* belt [?]), whose uppermost beds pass into the lowermost of the Petersburg belt; and finally a seventh belt C 1 or the *Fredericksburg* belt. The area (or areas) covered by Mesozoic near Hicksford, which constitute the portions of Mr. Heinrich's A 2, Prof. Fontaine does not name, as he acknowledges that he has not visited them.

Mr. Heinrich's lucid and careful observation of the rocks which follow that of the boundaries of his belts, cannot be too highly commended. They are classed as 1, Conglomerates; 2, Sandstones, (*a*) Psephites or Siliceous and Feldspathic, and (*b*) Psammites or argillaceous matter with fine siliceous sand and some larger grains of quartz; 3, Slates and Shales; 4, Limestones; 5, Coal, (*a*) bituminous, (*b*) carbonite, (*c*) natural coke, (*d*) semi-anthracite; 6, igneous rocks; 7, accessory minerals.

The following six pages are devoted to a very good sketch of the general geological and stratigraphical characters of the formation, consisting of some useful information as to areas of drainage.

This third division of his subject ends with a succinct description of the results of diamond-drill boring, and the separation of the measures pierced, into seven groups. This is an exceedingly interesting portion of the paper, each division is so clearly distinguished from the others by striking characteristics as to seize the attention of the reader, who is too apt to forget that he sees so clearly because he is looking through Mr. Heinrich's eyes.

The next six pages are given up to a detailed lithological description of the section by inches. The third chapter closes with a summary of the results of investigation, and an observation (confirmed by the study of the measures near Dillsburg, Pa.) that the largest beds of trap, more frequently followed planes of bedding than planes of cleavage.[1]

The fourth division of his subject is devoted to the fossil remains of the formation, but here Mr. Heinrich confesses his inability to do justice to the subject, and Prof. Fontaine's information is fuller and has the additional advantage of his own excellent critical judgment, at least so far as concerns the flora.

The fifth and last division of Mr. Heinrich's report regards the economical products of the formation, prominent among which, of course, is the coal. Forty-nine analyses are given on p. 42,

[1] Frazer's Report. CC, Sec. Geol. Surv. of Penna.

about equally divided between the north and south sides of the James river. On the succeeding page six analyses are given of West Virginia coals, and three from the Richmond basin. On p. 44 is a table of the coal shipped from the basin in various years, and the whole concludes with a comparative table of the total amounts shipped from the principal basins in Pennsylvania and Maryland, and from the Richmond basin.

The illustrations are on two plates; Plate I contains a map of Virginia and part of North Carolina, south of the Potomac and east of the Blue Ridge with the lines of strike of the four belts into which the author has thrown the formation. The areas of drainage are well marked on this map, and the Mesozoic shaded.

Plate II contains, Fig. 1, a geological section of the bore hole; Fig. 2, a section of the beds on a vertical plane perpendicular to the strike; Fig. 3, a long section along the James river from Richmond to Scottsville, showing a synclinal between the western and middle western Mesozoic belts, a synclinal in the middle eastern, and a probable eroded anticlinal between the latter and the eastern, where the rocks seem to dip under newer formations to and under the sea.

In this connection it is almost a pity to note even trifling errors in Mr. Heinrich's paper. These are not confined to "elliptic" for elliptical (p. 7), "dolorite" for dolerite (pp. 17 and 37), square acres (p. 41), and other similar oversights of the proof-reader in correcting the text, but may be even found in the maps, as in "Ezoic" for Eozoic (Plate II Fig. 3, &c.). It was to be hoped that these defects would have been corrected in the volume of the Transactions of the Institute of Mining Engineers, in which the paper appears.

Prof. Fontaine's Paper.—After his grouping of the outcrops of the Mesozoic previously given, the author notices a deposit of stones which plays an important part in the NW. They are neither conglomerate nor boulders. Under this head is classed the "Potomac Marble," which is all of limestone fragments. In the Pittsylvania belt, however, the stones are the product of the granite and azoic rocks lying near.

In his description of the Richmond basin, Prof. Fontaine has probably been led into error by Rogers and Lyell, and in spite of his own notes, when he says, "The lower series, from three to five hundred feet thick, rests immediately on the granitoid gneiss,

which forms the floor of the basin. It contains all the coal found in the field."

Mr. Heinrich's careful column shows the lowest coal (not counting occasional bituminous and carbonaceous slates and sandstones) is found at 571 feet from the granite, the second at 600 feet, the third and fourth at 655 feet.

On this subject Mr. Heinrich's remarks (p. 35) are very instructive; for even the variable distance noticed by the author between the granite floor and the coal could scarcely account for so great a discrepancy. The faults in the Midlothian region are conceded by all, and Mr. Heinrich's section presents a very rational view of them; but why "borings cannot be relied upon" is not clear, though of course their value as guides' decreases as the distance to the desired locality increases. One would suppose that they were all that could be relied upon.

A very interesting note in regard to certain varieties of the Potsdam strata, connect with this horizon the "compact vitreous quartzites and peculiar sandstones which have the grains of sand imbedded in a white, non-plastic, argillaceous matter," occurring a short distance above Harper's Ferry. Such rocks are indeed noticed elsewhere in positions entitling them to be considered Potsdam, but if by this are intended the quartz fragments imbedded in crystalline schist which make the high bluffs at Harper's Ferry on the Maryland side of the river, it is most interesting to note that they are strikingly similar to a great series composing the middle and western portions of the South mountain in Pennsylvania underlying the Orthofelsites and schists of probable Huronian age. Neither is the *Scolithus* a sure guide to the age of Potsdam in the opinion of all geologists.

The clay deposits and their supposed origin in "marshes within the Azoic area swept away in a general and extensive erosion," present certainly a new if somewhat hazardous line of dynamo-geological speculation, as also does the evident leaning of the writer towards a glacial movement to account for deposits of schists, granites, &c., on grit. It is noteworthy that Prof. Fontaine, Mr. Russell and others, each from his independent line of argument, arrives at the probability of a series of shallow and marshy beds to the south of the Mesozoic belts.

But the most novel explanation of the paucity of animal life in the Trias and Jura is that which supposes this time to have been *one* of great cold, when a huge ice sheet was advancing eastward

from the Blue Ridge, and its streams were feeding the Mesozoic areas. The ferns, cycads, &c., were furnished with a mild equable and moist climate by fogs from the Gulf Winds.

In this part of his argument it is difficult to follow the author, who would produce the glaciers by the cold winds sweeping east and north-east unchecked from the Pacific, while an "immense growth of coniferous trees covered the hills."

The problems with which Prof. Fontaine closes his paper, as to whether some of the drift in the northern States attributed to the Glacial period may not be much older; and whether there may not be drift deposits around the southern prolongation of the Appalachian chain. thus carrying an ice period into the far South to meet that of Prof. Agassiz in Brazil, are, as he says, well worth the attention of geologists.

In this paper the main points of interest are his belt of stones in the north-west and under the Catoctin range; his criticism of Schimper's determination of *Equisetum rogersii*, and his association of the ferns with the "Rhætic" beds, or their contemporaries, his establishing the drift matter of Azoic fragments in clay as passing under the Cretaceous in Maryland, and his conclusions as to the great eroding action of a glacier previous to or coincident with the laying down of this drift.

Mr. Russell's Paper.—This is concerned nominally with the New Jersey Triassic, but includes observations on the New England and British American Trias as well. These rocks and the protecting action of their traps in the bay of Fundy are first considered, and the tidal action on the soft muds is afterwards referred to as a good example of the kind of action which produced these soft ripple-marked shales.

In endeavoring to give, from a few localities in New Jersey, a general idea of the characters of these shales and sandstones, it must be confessed that either their variety is singularly curtailed on the crossing of the Delaware into New Jersey, or many of the diverse representatives mentioned by Messrs. Frazer, Heinrich and Fontaine must here be classed under the same names.

Note A refers to a *south-westward* dip of the Trias just east of the Blue Ridge in Virginia. Fontaine gives this dip of his "New Jersey belt" as north-west, while Heinrich's section makes it east or south-east.

An italicised paragraph seems to claim novelty for the conclusion to be drawn from the fact that in New England the dip of

the Trias was south-east, in New Jersey north-west, while in Virginia and North Carolina the flexed structure was apparent.

This is more definitely stated on p. 11, where by the aid of a diagram it is insisted that the Triassic beds in New Jersey and Connecticut are but flanks of a great arch, the upper portions of which have been removed by denudation. The lithological evidence which the writer has accumulated in favor of this old view must be considered of value. Mr. Heinrich enunciates the same view, pp. 22 and 23, but on the ground of supposed analogy between the James and Hudson rivers, and indeed this structure has been accepted, if not with the foundation which Mr. Russell now gives to it, by many geologists from the date of the first Geological Surveys of New York and Pennsylvania to the present time.

Apropos of the writer's views of the possible agency of the traps as lines of displacement, it is worth observing that the largest and strongest dykes are found by Frazer (Report CC, Second Geol. Surv. of Penna., p. 325), and Heinrich, to follow planes of cleavage. This fact, as stated in the first part of the above, is proof that no large amount of displacement took place, since the strata themselves and other beds of trap parallel with the bedding, which pursue one direction, and those cleavage dykes, are as so many keys to structure, for *no* displacement of beds could take place without displacing these. Rogers' theory of the apparent great accumulation of the Mesozoic beds is not quite correctly stated, p. 9 (See note on this subject in Frazer's Position of Am. New Red, &c., p. 5).

The supposition that the conglomerate was derived from the accumulation of pebbles at the mouths of rivers, is not borne out by observations of this characteristic rock along the western border of the Trias in Pennsylvania, for it is uniform in character for long distances, and according to Fontaine, the most abundant stones in Virginia could not have come from a point further south than the Lower Silurian of Pennsylvania.

The two authors, Prof. Fontaine and Mr. Russell, unite in their belief that the Triassic conglomerate is an important landmark in the formation, but they ascribe its origin to very different causes. Whereas the former imagines it to have been carried to its present position on ice rafts, the latter ascribes it to the deposition of numerous river mouths pouring out into the sound in which the rocks of this age were being laid down.

The text accompanying diagram, p. 16, is not clear, and therefore cannot be criticised. The conglomerates of Maryland and Pennsylvania do seem to mark two horizons near the upper and lower parts of the New Red series.

Another oversight is the assertion that the bold line of bluffs composed of crystalline schists can be followed to a distance from Stony Point, N. Y., towards Virginia, sufficiently far to account for the conglomerate of that edge as its shore deposit. Over long stretches of this intervening distance the only high ground is made of these coarse and hard beds.

In the summary of reasons for accepting the theory of unity between the New England and New Jersey Mesozoic, considerations Nos. 3 and 4 seem to be new and valuable. No. 1 is valuable. No. 2 if true of New Jersey is not so in Pennsylvania, where on the very eastern margin of these beds, in York county (as on the western), the rock is a conglomerate (See Report C, Second Geol. Surv. of Penna., and CC *Ibid*, p. 264. Section 6. Frazer). No. 5 on the continuity of elevated ground, if well founded from Hudson river to New England, is not so for the entire course south-west.

In the discussion of the eruptive rocks Mr. Russell makes a very interesting point in regard to the crescent shape of the outbursts of trap in the New England and New Jersey Trias. In the former the horns of the crescents turn eastward, while the convex side is towards the west, whereas in the New Jersey series this order is reversed.

But it is evident that the trap rocks of New Jersey must differ materially from those in Pennsylvania, and also in Connecticut, because he states that "they are usually composed of an intimate combination" (*sic*) "with some form of feldspar." They very rarely contain any hornblende elsewhere, and in the large collection of traps from Pennsylvania there are but one or two, and these from exceptional localities in which hornblende has been detected. Another difference lies in the fact that it is not difficult to find the junction of the trap with the shales and sandstones that underlie them. In Pennsylvania this is always difficult and sometimes impossible.

Mr. Russell expresses the same view of the effect of a sinking of the floor, or what is the same thing, a rising of the eastern margin of the Mesozoic area, as that given in CC, 2d G. S. of Pa., pp. 269 and 271.

Page 28, he under-estimates the amount of thickness of rocks with which he has to deal if he employ the "usual manner" of calculating it, for Rogers' and Frazer's sections of the New Red in Pennsylvania make the total thickness 51,000 feet.

It is interesting in Note B to find Mr. Russell also testifying to the probable high and swampy character of the southern end of the Triassic estuaries.

Taking the papers together, we cannot fail to recognize that they form a very valuable and suggestive arsenal from which to draw weapons to renew the old attack on the New Red.

——:o:——

ON UNSYMMETRIC ARROW-HEADS AND ALLIED FORMS.

BY S. S. HALDEMAN.

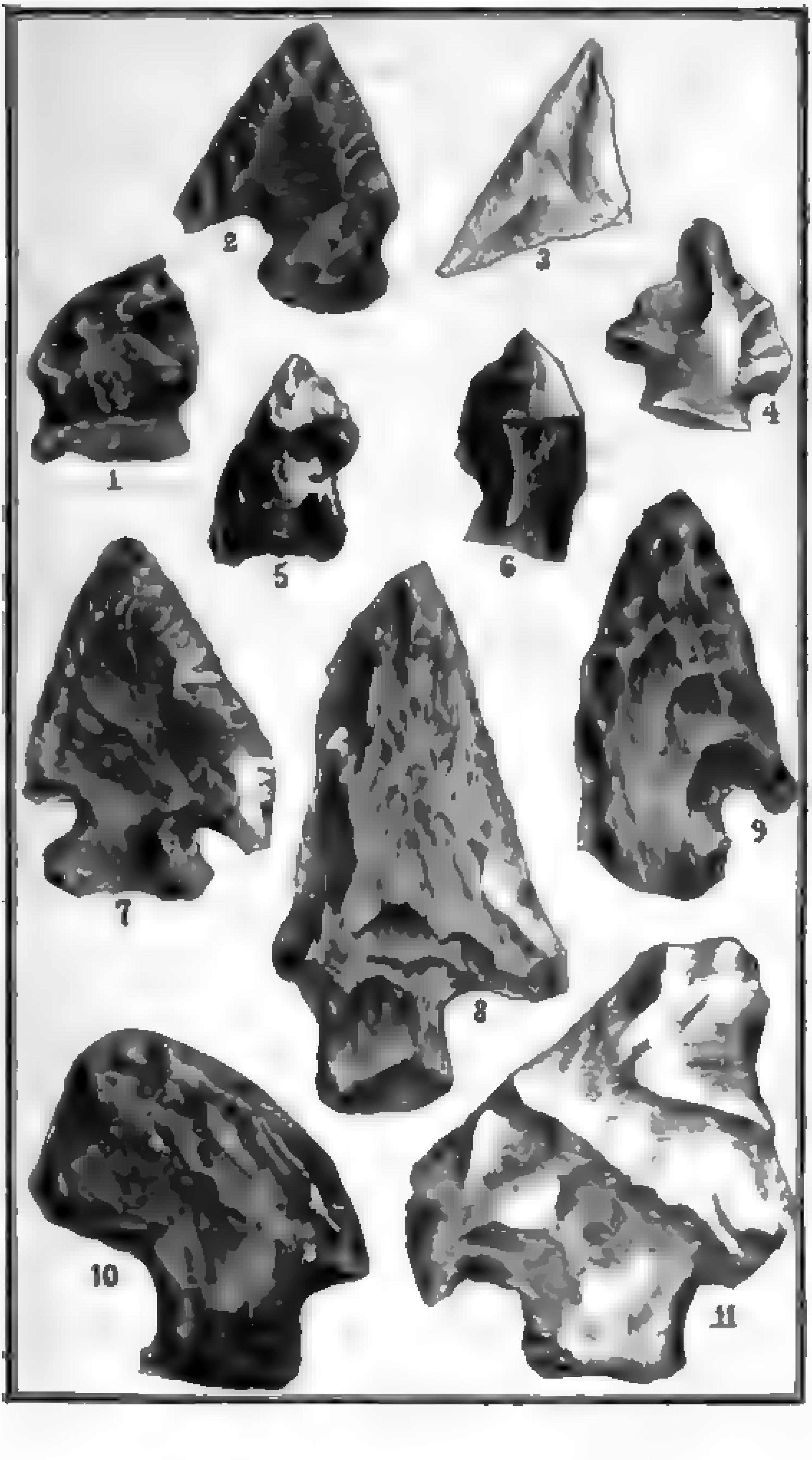
ALTHOUGH most stone arrow-heads have a symmetric outline, a large collection will generally present variations which may be due to unsuitable material, to want of skill in the workman, to a love of variety, to intentional adaptation to a purpose, or to the consideration that a single barb might be sufficient. Love of ornament appears in the use of paint,[1] and in the selection of finely colored jasper and chalcedony for implements.

While irregularities would interfere with the function of arrows, all these objects are not to be regarded as arrow-heads, some of the larger kinds being for spears, while others are probably borers (Fig. 4), scrapers (Fig. 10) and knives (Fig. 8). As in civilized life, the workman whose kit is limited must make one implement serve the purposes of several. In fact, the enterprising explorer, Major J. W. Powell, brought from the Rio Virgen small knives of what would be regarded as arrow-heads if found detached, but which were fastened (with the gum of *Larrea mexicana*) in a notch in the end of a round wooden handle (see Fig. 1, p. 2, in Rau's Archæol. Collections of the National Museum).

The want of symmetry may be in the form of the body (Figs. 1, 3, 4, 8), in the shape and inequality of the barbs (Figs. 7, 11), and in the slight indication, or the absence of one of the barbs (Figs. 2, 5, 6, 8, 9).

A barb may be accidentally broken off during or after making,

[1] I have an arrow-head from Tennessee, one side of which is painted with a ferruginous red color.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as shown in many examples where the surface of fracture remains. In others, the unarmed side is finished uniformly, as in Fig. 9, where the simple edge runs from base to point, but we may infer that a workman would economize a broken specimen by shaping it anew, as basal and terminal halves are turned into scrapers.

Want of symmetry in the barbs occurs in the short sub-triangular forms (Fig. 11) which are often of large size, with one prominent barb—forms probably intended for fish-gigs.

Mr. Ch. C. Jones (Antiquities, p. 266–7) does not figure abnormal forms, which he regards "as examples rather of misfortune than of original design." But even failures are worthy of record, and some of the forms may have been adapted to a purpose.

Figs. 1, 2, 4, 5, 6, East Tennessee (L. and F. A. Stratton); Fig. 3, an obtuse-angled triangular form, with all the edges sharp; the base or shortest side in some specimens slightly convex; probably knives and scrapers; white quartz; Chester county, Pa. (H. R. Kervey); in the one figure the base is longer than usual. Fig. 5 resembles an equilateral form, in one side of which an indentation had been made to adapt it for scraping, or for tying it to a handle; black flint. Fig. 7, Liberty county Ga. (Dr. J. L. Le Conte.) Fig. 8, Pennsylvania (?). Fig. 9, Arkansas (?). Fig. 10, Bainbridge, Lancaster county, Pa. (F. G. Galbraith); the longest edge is dulled and smoothed by use, as if in polishing or scraping the inside of earthenware. Fig. 11, Tallahassee, Fla.; white semi-opal (C. N. Haldeman). The figures are of the size of the originals.

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EXAMINATION OF INDIAN GRAVES IN CHESTER COUNTY, PENNSYLVANIA.

BY EDWIN A. BARBER.

IN the year 1824 there appeared in the *Village Record*, at West Chester, then edited by Charles Miner, Esq., a long and elaborate series of communications written, evidently, after careful research and personal inquiry, by Joseph J. Lewis, Esq., then a young law-student, and now one of the most distinguished members of the bar of Chester County."[1] In

[1] Historical Collections of the State of Pennsylvania. By Sherman Day. Phila., 1843. Page 207.

one of these communications the following paragraph appeared: "There is a place near the Brandywine, on the farm of Mr. Marshall, where there are yet a number of Indian graves that the owner of the ground has never suffered to be violated. One of them, probably a chief's, is particularly distinguished by a head and foot stone."[1]

Having recently obtained permission from the present owner of the property, Mr. Caleb Marshall, some of the members of the Philosophical Society of West Chester, on the 16th of November, 1878, proceeded to investigate these graves. The burial-ground is situated in a group of hickory and oak trees on a prominent knoll some three hundred yards to the north of the west branch of the Brandywine or Minquas creek, formerly known to the Indians as the *Suspecough*. "The Indians upon the Brandywine had a reserved right (as said James Logan in his letter of 1731) to retain themselves a mile in breadth on both sides of one of the branches of it, up to its source."[2]

The exploring party found traces of at least thirty graves, indicated by shallow depressions, but originally there was a much larger number, as Mr. Marshall asserts that the plough has been gradually encroaching upon the cemetery, all signs of many of the graves having been entirely obliterated. The portion yet protected by the receding grove, however, has never been disturbed.

Four of these burial places were opened, with the following results: In the first grave, at the depth of three feet was found a skeleton stretched at full length on the back, from east to west, the face turned toward the north-west, the arms extended close to the body. Around the neck were nineteen spherical, opaque, milky-white, Venetian beads, each about an inch in diameter. These glass beads are similar to some found in Northumberland county and other portions of the State, and had undoubtedly been supplied to the Indians by the early settlers. This grave was filled with the prevailing red clay of the surrounding country and was exceedingly stony and loosely packed. The skeleton rested on a rude floor of rock.

In the second grave another skeleton was unearthed, at the depth of three and a half feet, having the same orientation as

[1] Ib., p. 208.

[2] Watson's Annals of Philadelphia, Vol. II, p. 160.

number one, but lying on the left side, with the face turned upwards. Associated with the skeleton were the following articles: Around the neck was found a large number of European beads, consisting of ten-sided amber-colored glass beads the size of a large pea, and quantities of small cylindrical Venetian beads colored white and blue. Three objects of aboriginal workmanship were also found in this grave, consisting of two finely chipped *gun-flints* and a highly polished flat elliptical stone of a dark color, three inches in length. These were the only articles of native manufacture found in any of the graves. A quantity of a red clayey substance resembling paint occurred in this grave, which in all probability had been employed by the Indians in personal decorations. Close to the right hand of the body were found two European white clay-pipes of a pattern employed during the seventeenth century; on the bowls the maker's stamp (R T) was impressed.[1] Around the skeleton were found thirteen wrought-iron nails, two to three inches in length, much corroded, with fragments of decayed wood adhering to them. The body had evidently been enclosed in a wooden box.

In the third grave, three feet nine inches below the surface, were found a skull and portions of bones much decomposed, the body extended on the back, face up, head toward the east, as in the preceding cases. In this grave nothing was found associated with the skeleton save a single coffin nail.

Grave number four revealed nothing but some fragmentary bones.

Mr. Marshall states that a couple of stones years ago were found on the surface of the burial-ground, which were covered with pictorial etchings. These were doubtless the same alluded

[1] In the beginning and middle of the seventeenth century, pipes were made by various makers in the vicinity of Bath, England. Amongst these was Richard Tyler, and the initials R. T. in all probability were impressed at his manufactory. We can, therefore, with some degree of certainty assign to these pipes an approximate date. The earlier British pipes, sometimes called "Elfin" or "Fairy Pipes," and by some antiquaries attributed to the *Romans*, made, however, in the reign of Elizabeth, frequently possessed the initials of the makers' names on the bases of the flat spurs which characterized them. These were gradually superseded by pipes with elongated bowls, in which the spurs or heels were pointed or entirely absent. The more recent English pipes of the last century or thereabouts had the names of the makers stamped on the stems. The examples in question are of the elongated pattern, minus the heel, with the initials stamped in the *bowls*. The stems have been broken off about six inches from the bowls, having been originally longer. They were brought to this country by the earlier settlers and traded to the Indians.

to by Mr. Lewis, and in all probability marked the resting-place of some distinguished man of the tribe. Unfortunately they were removed and carelessly thrown into the public road some time ago, where they probably remain to this day imbedded in the soil. The exact location of these interesting relics, however, can only be surmised, and in all probability they will never be recovered. Indian Hannah, the last of this branch of the Lenni Lenape, died in the neighborhood, at the Chester county almshouse, in the year 1803. The graves above described resemble, in many features, others opened near the Delaware Water Gap, a few years ago. The skeletons in the latter lay at a depth of two and a half to three feet and were extended from east to west, some of them being enclosed in rude stone coffins. The contents were also similar, consisting for the most part of objects of European manufacture. In Venango county also, in the vicinity of Franklin, a number of Indian tombs have been opened, in which were found remnants of fire-arms and copper and iron implements.

Skeletons.—The bones found in grave number one were much decayed, and consisted of skull, one humerus, both ilia, femora, tibiæ and fibulæ, besides some of the vertebral joints and finger bones with decayed fragments of ribs. The femur, allowing for the decay of the extremities, measured eighteen and a half inches in length, from the upper edge of the head to the base of the inner condyle. Grave number two produced, besides the cranium, a few of the long bones, very much decayed. The third grave contained simply the skull and some small fragments of bones. The fourth grave had evidently been exhumed at some previous time, as the few broken portions of bones it revealed were much displaced. About twenty-five years ago two of these tombs were opened in the night by a party of relic hunters, and in all probability this was one of those which had been disturbed.

Crania.—The following brief description of the skulls, taken from notes hastily jotted down in the field, will convey a general idea of their main characteristics, but I hope shortly to prepare a more exact description of them, as they are at the present moment not accessible to me. Skull number one is somewhat prognathous; teeth normal and excellently preserved, but the crowns, especially of the molars, are much worn by the use, probably, of maize. The general appearance and massiveness of the cranium would indicate that the subject was an adult male. Skull number two ex-

hibits a marked prognathism, though the superior maxillary was lost in its exhumation. The lower jaw is exceedingly massive, the teeth abnormal and number but eleven, the eruption of the last molar on either side having never occurred. The skull evidently belonged to a young warrior, and probably one of some celebrity, as the elaborate decoration of his grave would denote. Skull number three is probably that of a female. The walls are more fragile and show smoother surfaces than the former. Besides this, there was nothing of personal adornment found in the grave. This was the most perfectly preserved cranium of the series. The number of teeth in both jaws is complete. The skull is decidedly asymmetrical; viewed from above, the compression is seen to be on the right side, but this deformation is undoubtedly accidental. It presents a more orthognathous form than the two preceding.

The late Anders Retzius, of Stockholm, who devoted much attention to the study of the craniology of the American tribes, classes the Algonquins and Iroquois with the dolicocephali or long-heads. This point, however, cannot be satisfactorily determined until sufficient material be collected for more extensive measurements. The few Lenni Lenape skulls which have thus far been recovered, present such variable features that a general average of a large number must be obtained before we can arrive at any satisfactory results. There are some ethnologists who place the modern Indian tribes of America with the brachycephalic or short-headed class. It is exceedingly desirable, for the purpose of comparison, that every opportunity be embraced for obtaining and preserving the skulls of this tribe, as in a comparatively short time all traces of them will have irrevocably disappeared.

The discoveries in these graves go to prove that the inmates were among the last of their tribe who lingered on the banks of their dearly loved stream, ere the remnants of their people gathered themselves together and sadly wended their way westward. They had adopted, to a considerable extent, both in their manner of living and the disposal of their dead, the customs of the whites, with whom they had been thrown into contact for a number of years. The local legends and memories of the oldest inhabitants ascribe to these graves an age of about a century and a half, though some of them may be much more recent, as it is not probable that the entire number of interments were even approxi-

mately synchronal. We find that the method of inhumation practiced by this local clan or branch of the tribe did not differ materially from that of other divisions situated in other portions of the State. The bodies were generally extended at full length from east to west, sometimes encased in rude stone cists, but more frequently laid to rest with no covering except the vestments which had been worn in life. Occasionally, as we have seen, under the influence of civilization, the departed were encased in wooden coffins, furnished the tribe undoubtedly by their European neighbors.

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NOTES ON SOME FISHES OF THE COAST OF CALIFORNIA. No. 1.

BY W. N. LOCKINGTON.

THE accompanying notes are chiefly the result of periodical visits paid to the markets of San Francisco during the months of October, November and December, with the object of ascertaining the comparative abundance of the various species, the localities where they are taken, their value as articles of food, etc., etc.

No attempt at classification is made, and in the generic names I have in most cases followed Günther, with whose works I am better acquainted than with those of Gill. *Sarda* is substituted for *Pelamys*, which is also the title of a genus of Hydrophoid snakes, and Prof. Jordan informs me that the snakes have a prior right to it.

The icthyology of the Pacific coast of North America is as yet far from being fully worked out; in many cases there is considerable confusion of names, and little is known respecting the food, habits, spawning season, &c., of most of the species.

Several rare and some probably new fishes have been brought to the markets this year, principally because the fishermen use trawl-nets to a greater extent, and trawl to a greater depth than they were previously accustomed to do.

Ambloplites interruptus Grd. Sacramento River Perch.—This species is abundant along the lower course of the Sacramento and San Joaquin rivers, and in all the branches of those rivers that permeate the lowlands; and forms an important article of

food not only to the white inhabitants of the district, but also to the Chinese, who are particularly fond of it, catch it in immense numbers and forward it to their countrymen along the railroad as far as the boundary of the State, or even beyond it. It is usually taken in fyke-nets, which are most effective engines of destruction. It is occasionally brought to the markets of San Francisco, but has not been at all common there during the months of October, November and December. It is a very good fish for the table, unless taken in sloughs that by the falling of the water have become disconnected with the river.

Anoplopoma fimbria (Pallas) Ayres, Candle-fish.—This species is very rare in the markets of San Francisco, but appears to have been more abundant this year than at any previous period.

Dr. W. O. Ayres (Proc. Cal. Acad., 1859) states that in his time stragglers only occurred in the markets; and the fish-mongers call it a " new " fish, and declare they have never seen it before. Dr. Ayres gives the number of rays in the first dorsal as twenty-three, but I can only find twenty-one in the specimens I have examined. Probably the number varies slightly. The outline figure in the Proc. Cal. Ac. Vol. 1, 1859, shows twenty-two. The tail is much more deeply emarginate than is shown in the figure, as the central rays are only about half as long as the outer ones. Most of the individuals brought to the markets this year were not over ten inches in length, but Dr. Ayres states that he saw one that measured eighteen inches. The fishermen call this species candle-fish, but whether on account of its oiliness, of its length and slenderness, or of a fancied resemblance to the species called candle-fish in Oregon and northward I cannot tell. The last-named candle-fish (*Ammodytes personatus* Grd.) is not at all nearly related to the present species, but belongs to the *Ophidiidæ*, a tribe approaching the eels in many particulars; it is so oily that it is said that the Indians make their candles by pulling their yarn through its flesh. Since October *A. fimbria* has not occurred in the markets, but it is not unlikely that the severe weather which prevents the fishermen from trawling is the cause of this.

Ophiodon elongatus Gir., Green Rock Cod.—This is one of the largest and commonest of our marketable fishes, frequently attaining a length of over three feet; and is usually in great part of a lively green color, spotted or clouded with light brown. But the coloration of the adults varies greatly, the brown markings sometimes

cover almost the entire fish, and different shades of brown occur in the same individual. The young is spotted with round spots of a light yellowish-brown, and it was to the young that the name *Ophiodon elongatus* was originally given by Girard, who described the adult with the title of *Oplopoma pantherinum*. *O. elongatus* was said to have a continuous dorsal with twenty-seven spines, and no membranous flap upon the forehead; while *Opl. pantherinum* was characterized by two separate dorsals, the first with twenty-five spines, and by the presence of a membranous flap,

Dr. Steindachner corrects this error (*Icthyologische Beiträge*, No. III), and proves that the continuous dorsal and membranous flap are characters of the species.

The correct number of spines is twenty-seven, but the adult frequently comes to market in a dilapidated condition, with the spines torn apart from each other, or even broken away, and it is most probable that Girard described his *O. pantherinum* from such a mutilated specimen. Young and half grown individuals are common in the bay of San Francisco, but the larger examples are taken in tolerably deep water outside the bay, especially in the vicinity of the Farallones. A large individual that I measured as it lay upon the stall was three feet two inches long. Steindachner gives the range of this species as from Sitka to Monterey.

Chirus constellatus Grd., and *C. guttatus* Grd.—These species have been brought to market regularly, though not in great numbers, throughout the three months under review, and indeed appear to be always in season. Those brought to market are usually taken in the bay.

Scorpænichthys marmoratus Grd., the large red sculpin.—Despite the absence of scales upon its body, this species is commonly styled a rock cod. While its nearest relations, the smaller sculpins, or catfish, as they are often called here, are thrown away by the fishermen, this large sculpin is allowed a place among our food fishes. *A priori* one would expect the other sculpins to be good food, and I am assured by those who have tried them that they are; all they need is skinning before cooking.

Sebastes fasciatus Girard, clouded rock cod.—The name *fasciatus* is much less appropriate than Ayres's name of *nebulosus* (over which it appears to have the right of priority), since the broad light-yellow band which suggested the name is usually

absent, and the dark and light tints of the sides of the body are mingled together without any regularity. This is one of the smallest of the genus, but has been known to reach the weight of seven pounds.

Sebastes nigrocinctus Ayres, black-banded rock cod.—This is one of the rarest of our edible fishes, as only single individuals are brought to the market at considerable intervals of time. Only two specimens have hitherto come under my notice, and one of these has the black transverse bands much more developed than the other. It is not taken inside the bay.

Sebastes rosaceus Girard, smooth red rock cod.—This species appears to attain a larger size than any of its congeners except *S. ruber*, which it equals in length but not in weight, as it is more slender and seldom or never exceeds fourteen pounds in weight. *S. rosaceus* is taken outside the heads.

Sebastes melanops Girard, black rock cod.—This fish does not usually attain so large a size as *S. ruber* or *S. rosaceus*, at least in the locality where it is usually taken, viz: within the bay of San Francisco. It is one of the commonest kinds of rock-fish.

Sebastes ruber Ayres, rough red rock cod.—This, the largest of the genus occurring in our waters, is stated to reach, though rarely, a weight of twenty-five pounds. It is of a uniform bright red, very different from the brownish-red mingled with orange-red, which forms the livery of *S. rosaceus*. In form it is stouter than *S. rosaceus* but less so than *S. fasciatus*. It is taken outside the bay, usually from deep water around the Farallone islands. It occurs also northward at least as far as Humboldt bay.

Sebastes auriculatus Gir., black-shouldered rock cod.—This is rather a small species, seldom exceeding eighteen inches in length, and is brought to the markets in great abundance, probably on account of its common occurrence in the bay. Not only does this species occur, together with two or three others of the smaller kinds of *Sebastes* and the young of the larger kinds, in the deeper portions of the bay near the entrance, but it is also abundant along the eastern shore of the bay, where no other species of the genus is found, probably on account of the admixture of fresh water from the Sacramento river.

Sebastes helvomaculatus Ayres, pink-spotted rock cod.—This is smaller even than *S. fasciatus*, not equaling it in length and of much more slender form. The three elongated pink spots along

each side are constant, and at once distinguish it from every other species. In color it resembles *S. ruber.* Though not so common as *S. auriculatus*, or *S. melanops*, or even as *S. nebulosus*, *S. ruber* or *S. rosaceus*, it is occasionally brought in, in considerable numbers.

For all the above species of *Sebastes*, as well as for *S. flavidus* Ayres, *S. paucispinis* Grd., and *S. elongatus* Ayres, the fishermen have no other English names but rock cod or rock fish, although they can readily distinguish between the species. I have, therefore, coined names for them from their most obvious characteristics. All the species named, except *S. elongatus*, have occurred in the markets during the months of October, November and December. The names rock cod and rock fish are also applied to the various species of *Chirus*, to *Ophiodon elongatus* and even to the scaleless *Scorpænichthys marmoratus*.

Sphyræna argentea Grd., the barracuda.—It is well not to be misled by English names; that of *Barracuda* is applied not only to all the species of *Sphyræna*, of which there are several, but also to fishes of other families, and even other orders. In the rivers of South America the name is given to the *Sudis* (*Arapaima*) *gigas*, a soft-finned, large-scaled, fresh-water, carnivorous fish. All barracudas, however, are fierce, rapacious fishes, and the one we are at present considering attains a length of over three feet, and a weight of from twelve to fourteen pounds. The form is slender but it is nearly as thick as it is deep, and its jaws are armed with a formidable row of sharp teeth. When darting through the water it looks like a silver arrow. It is usually obtained south of the bay and at the Farallones, but occurs at least as far north as Tomales. Its flesh is very good eating, so that if it devours our food fishes, we may console ourselves by devouring it.

Genyanemus lineatus Gill, *Sciæna lineata* Günthr., the kingfish.—This species was formerly common in the bay, but since its waters have been defiled with so much tar and drain refuse by our destructive and imperfect civilization, it has become scarce, and is now usually obtained outside. It is, in my opinion, one of the most delicate of our food fishes.

Sarda lineolata Girard.—This, like all the Pacific coast Scombridæ, is not very often brought to the markets of San Francisco, and is, therefore, a high-priced fish. Those that come here are caught in Monterey bay.

Günther (Cat. Fish. Brit. Mus., II, 368) considers this species to be identical with the *Pelamys chilensis* of Cuv. and Val. It attains a considerable size, a series of four specimens lying on the stalls in November of this year measuring respectively two feet two and a quarter inches, two feet two and three-quarter inches and two feet three and a half inches, from tip of snout to fork of caudal fin. The caudal fin cannot be said to be crescentic, as stated by Girard, since its posterior margin forms two sides of an obtuse isosceles triangle. The sides and belly are silvery, becoming bluish-black towards and on the back, and five or six obliquely longitudinal bands of the darker tint run along the sides.

Scomber colias, Spanish mackerel.—The *Scomber diego* described by Ayres (Proc. Cal. Ac., I, 1857, 92) has been proved by Steindachner to be identical with the long-known *S. colias* or Spanish mackerel of the European seas. Steindachner states that it occurs frequently on the coasts of the Galapagos islands, and wanders in small shoals along the Californian coast as far as San Diego, also that single individuals occur near San Francisco. I have never seen this fish in the markets, but the fishmongers appear to be acquainted with it. Thus this species and *Albula vulpes* are among the few fishes which inhabit both the Atlantic and the Pacific oceans.

Stromateus simillimus Ayres, pompano.—This species was first described by Dr. Ayres (Proc. Cal. Acad., Vol. II, p. 84, fig. on p. 85) in December, 1860, and accompanied by a good outline figure. Dr. Ayres states that in the course of seven years he only saw three or four specimens; but this year, at least, it is far more abundant, as I have seen as many as thirty or forty on the same stall on two or three occasions during October. As with the other Scomberoids, the examples brought to this market are caught in Monterey bay, which appears to form the northern limit of many species of fishes, crustacea and echinoderms.

As in the arrangement of the fishes in the Museum of the California Academy of Science, we are, at present, following the classification of Dr. A. Günther, of the British Museum, the name of this species must be changed from *Poronotus simillimus*, the title given it by Dr. Ayres, to *Stromateus simillimus*; as Dr. Günther admits no such genus as *Poronotus*, and it agrees with *Stromateus* in the entire absence of the ventral fins, short elevated form of body, and single long dorsal and anal fins.

The Italian fishermen call this species "pompino," and this must be accepted, in the absence of any other, as its English name. I am informed that a fish called "pompino," on the Atlantic coast, is considered to be the most delicate of all fishes; this is *Trachynotus carolinus*, a very different species. Our "pompino" is also highly prized as a delicate morsel, and is one of the dearest fishes in the market.

Mr. B. B. Redding has given me an account of a little practical joke in which the New Orleans species of pompino is concerned. When, during the civil war, Dr. Russell was in this country as correspondent, I believe, of the *Times*, he was so anxious to taste the celebrated pompino that he obtained leave to pass through the lines and visit New Orleans for the purpose. It happened, however, that pompino was not in season, but a perch of somewhat similar size and form, aided by the cookery of a clever negro cook, was passed off upon him as pompino. Dr. Russell ate, relished exceedingly, and wrote to his paper a glowing description of the gustatory delights of pompino, and it was not till some years after that it transpired that pompino was not then in season, and that he had been put off with perch.

Mugil mexicanus (?) Steind.—Several specimens of a species of Mugil, evidently very close to the above species, if not identical with it, have found their way to our markets in the months of September and October. All of them were taken near Santa Cruz, in the bay of Monterey.

The specimens examined agree with *M. mexicanus* in the number of scales in the lateral line, and of rays in the vertical fins, in the length of the latter, in the produced upper caudal lobe, and in the proportions of the body and head, and I should not hesitate to pronounce them to be of that species were it not that Mr. B. B. Redding, one of the Fish Commissioners for the State of California, has informed me that about three years ago he placed several (I believe about forty) individuals of a Mugil from the Sandwich islands in the Sacramento river, and it is, therefore, possible that the specimens obtained may be some of these, or their young. I suspect this because the shad introduced from the East, finds its way in considerable numbers to Monterey bay, instead of dutifully returning to the place of its birth, and this Mugil may have acted in a similar way; also because the specimens agree tolerably well with the diagnosis of *Mugil cephalotus*,

given by Günther. The inter-mandibular space agrees pretty well with Günther's figure of that of *M. cephalotus*, but it is still nearer to Steindachner's figure of *M. mexicanus*. As this is a mullet, it is of course tolerably good eating, but it must be remembered that it is not nearly related to those famous delicate fishes, the red mullet and the surmullet, which were so highly prized by the Romans that they fed them in aquaria, but to the gray mullet. The first-mentioned fishes belong to the *Mullidæ*, and are provided with a barbel, the latter and our Californian fish to the *Mugilidæ*, which has no barbel and no teeth worth speaking of.

Brosmophycis marginatus Ayres.—This is a very rare species, so much so that although it is taken in the bay of San Francisco, I have as yet seen only a single specimen, and Mr. Johnson, of the California market, whose practical knowledge of fishes can be safely relied upon, informs me that in the three years that have elapsed since he first noticed it, he has only seen three individuals. *Marginatus* is a very good name for the fish, as the long fin which encircles the greater half of the body, undivided into dorsal, anal and caudal fins, is of a vivid red in the fresh fish, and forms a most conspicuous margin. The exudation of mucus from the surface of the skin is most abundant, rapidly forming an epidermal covering, and it is therefore no wonder that my friend Mr. Johnson characterized it as a kind of eel. In thus naming it he was not so very far off after all, since the family *Ophidiidæ*, to which it has been referred by Dr. Günther, is in many respects intermediate between the *Gadidæ*, or cod tribe, in which it was originally placed by Dr. Ayres (under the name of *Brosmius marginatus*), and the *Murænidæ*, or eel tribe. As it has hitherto had no English name, I venture to call it the red-fin, on account of its most obvious peculiarity. The family *Ophidiidæ* contains some species of parasitic habits, vertebrates parasitic upon invertebrates, a strange inversion of our ordinary experience.

Smelts.—Several species of fish are commonly sold in this city under the collective name of "smelt." The species usually met with are *Atherinopsis californiensis* (Girard), *A. affinis* (Ayres), *Hypomesus olidus* (Pallas) Gill, and *O. smerus thaleichthys* (Ayres).

The two last of these are Salmonoids, and therefore have a right to the name of smelt, but the two former belong to a very

different family, the *Atherinidæ*, and are said to be much less delicate in flavor than the others. A third *Atherinopsis*, *A. tenuis*, was described by Dr. Ayres (Proc. Cal. Ac. Sci., II, 75, fig. on p. 76) but it is very rare, and I have not yet seen it.

These fishes may be readily distinguished as follows: The two kinds of *Atherinopsis* have two dorsal fins, the first very small, placed about in the center of the length of the back, and formed of *spines* or stiff rays, the second rather larger, and separated by an interval from the first. Their prevailing color is light green.

The two Salmonoids have a dorsal fin, formed of *soft* rays, in or near the center of the dorsal outline, and a fleshy fold, or "adipose fin," placed farther back near the tail.

Atherinopsis californiensis is a larger fish than its congener, reaching a length of seventeen inches, and it may be distinguished by its larger head, more slender form of body, larger mouth and the central position of the first dorsal.

In *A. affinis* the dorsal is nearly its own length further back, the form of the body is much stouter, the head proportionally smaller, the mouth smaller, the fins larger and the flesh firmer. Dr. Ayres states that this species never exceeds eight inches in length, and this size must be but rarely attained, as the specimens I have seen in our markets seldom pass six inches, while *A. californiensis* usually exceeds twice that length.

Osmerus thaleichthys is really the nearest representative of the smelt of Europe, having the peculiar, pleasant smell that suggested the name in that species, which is also a kind of *Osmerus*.

It may readily be distinguished from the two previous species by the want of spinous rays on the back, by the adipose fin, by the absence of the bright green tint which is replaced on the back by a dull greenish-olive, on which a diamond pattern is traced by rows of minute dark dots that fringe each scale, and by its smaller size. From the other small Salmonoid it may easily be known by the comparatively large size of the mouth and less transparent appearance. It is usually from five to five and a half inches in length. Its form is stouter than that of *Hypomesus olidus*, the flesh is soft in texture, and the pectoral fins reach very nearly to the origin of the ventrals.

Hypomesus olidus (Pallas) Gill, is called "whitebait" by those who are familiar with the delicate fish known by that name in England, yet is not very nearly related to the real whitebait, which is asserted by Dr. Günther to be the young of the common

herring of the Atlantic. Its dimensions are about the same as those of the preceding species, but the mouth is very small, the end of the maxillary bone reaching only level with the front of the eye, while in *O. thaleichthys* it reaches to the back of the orbit. The head also is somewhat smaller. But this fish, when fresh, can be most readily distinguished by the transparency of its flesh, which, of course, disappears entirely in preserved specimens. The silvery band along the sides, which is found in all the four species, and is probably the cause of their being grouped together as smelts, is particularly bright in this fish.

I have not yet been able to ascertain at what season each of these species may be most common, but all are abundant in the markets throughout October, November and December.

Albula vulpes (*Albula conorhynchus* Günthr., Cat. Fish. Brit. Mus., VII, 468).—This widely distributed species has been found at various points along the Pacific coast of North America. Günther (Cat. Fish. Brit. Mus. VII, 469) mentions its occurrence on the coast of Central America; Steindachner (Sitz. Ak. Wiss. Wien., 1875, 61) incidentally states (in his description of *Mugil brasiliensis*) that it is found at San Diego; in the same year I received two specimens from Lower California, probably from Magdalena bay, as the fishes accompanying it came from that place; and lastly, in September, 1878, several specimens were brought to the markets of San Francisco. The fishmongers could not tell the exact locality from which these individuals were brought; but as few, if any, marine fishes find their way to our markets from points south of Monterey bay, and as that bay is frequented by many other fishes which are not found, except as stragglers, to the northward of it, I think it probable they came from thence.

The specimens from Magdalena bay (Lockt. Proc. Cal. Ac., 1876, 83) were most beautiful in their coloration, glowing with burnished silver below, deepening to gold upon the sides, and to darker metallic tints on the back; but those found in the markets this year were uniform silvery, as described by Günther.

By a typographical error in my Notes on Californian Marine Fishes (loc. cit., p. 84), the length of the example from Lower California is given as 3″.7 instead of 1′-3″.7. Those brought to market this year were only partly grown. The question arises whether the metallic colors are confined to the adults, or are the result of peculiarities in the environment.

RECENT LITERATURE.

Report of the Committee of the House on Coins, Weights and Measures.—The late Congress has given the country abundant reasons for never wishing to see it again, but it remained for it to add as an appropriate headstone to mark its grave the above report. This committee was composed as follows: A. H. Stephens, Chairman; Levi Maish, Robt. B. Vance, J. B. Clark (Mo.), R. M. Knapp, H. L. Muldrow, J. B. Clarke (Ky.), M. S. Brewer, Thos. Ryan, J. W. Dwight, R. L. Gibson. To all appearance these gentlemen have embodied their views on the metrical system in a report of 234 pages. This report contains a collection of various works, reports, tables, &c., &c., from many sources, and in so far as the printing is accurate perhaps the labors of the committee have not been fruitless. But it is too evident that there has been no original thinking done by the committee on this important subject, nor do they seem to understand the contributions of others, while the form of the report is such as to make it appear that work done by others was done by the committee.

The introductory lines, which are doubtless original with the compiler of this report, are not, either in literary or statistical merit, up to the standard of what he has scissored. Thus we read, p. 6, that "Phidon of Argos *in Greece*, nearly a thousand years before the Christian era, gave the subject (?) his profound attention, but with no nearer approximation to what was wanting than any of his predecessors," &c.

The picture of Pheidon (?) of Argos profoundly attentive while far, far away from the desirable but missing, is touching. Poor Pheidon would have been reveling in the closest propinquity (at least by comparison) could he have only survived long enough to be placed in possession of this report.

The carelessness of this pot-pourri (or perhaps *rag*out would be more appropriate) is not only exhibited in the manner in which good pieces of work have been put together, but in the perpetuation of the radically wrong relation between the inch and the meter expressed by the number 39.370432, a number accepted by no persons on the globe except those directly influenced by the office of the United States Coast Survey.

Page 8, we read that "Some writer has said that the adoption of the Metric System in solving mathematical problems (?) in our public and private schools would save one full year's hard study in a boy's or girl's collegiate course."

Passing over the loose and only partly intelligible style of this statement, it is fair to presume that it grew out of "some writer's" ill remembrance of the following paragraph on the back of one of the Metric Bureau "Broadsides:"

"The Hon. John Yates (an Englishman), after protracted inquiry and investigations in the schools and among those best able to

judge of the matter, reported that the complete adoption of the decimal, in place of the present English weights and measures, would save two full years in the school-life of every child educated. In our country the saving would be something less, because of our adoption of the decimal currency; but the most conservative teachers acknowledge that something like this amount of time would be saved each child if our present confusion of measures were entirely replaced by the International or Metric System."

It should be said in justice to the composer of this report that his English is no worse than that signed by seven distinguished names (p. 57), of which the following is a sample: "It is gratifying to know that the President of the United States, on having been consulted by Mr. Washburne upon the question of affixing his signature, was authorized by telegraph to do so, and signed the convention accordingly."

It was no doubt very kind of Mr. Washburne to permit the President to sign the convention, but who did Mr. Washburne represent?

We must conclude this hasty summary of the Report of the Committee on Coins, Weights and Measures, by drawing attention to the fact that the three tables published in Frazer's pamphlet on the "Proposed Substitution of the Metric for our own Weights and Measures," appear on p. 229 and the unnumbered following page of the report are without the slightest acknowledgment of the source whence they were taken.

This is the more remarkable in the table called "Distribution of English Units," because this is a photograph of a free hand diagram of Mr. Frazer, which was improved in the pamphlet above referred to. It contains a patent error (as here produced) in the line which leads up from the "Rod Pole or Perch" to a group with which this length has nothing to do. This error does not appear in the pamphlet printed in 1877.

We would sum up this report by saying that it illustrates but too forcibly some of the gravest defects in the present system of doing the work of our Government. The object which the committee endeavors to further is a good one, viz: the unification of weights and measures; but the M. C. of the last Congress could not bestow the time upon this question of pure statesmanship which its proper understanding requires, and it is but too clear that some underpaid clerk has been delegated by the members to make an indigestible salmagundi of all that has been done, with orders not to stop short of the two hundredth page. Thus more copy is afforded our merry Government presses, more disjointed thinking supplied for trunk linings and lamp lighters, while the committee may have the satisfaction of knowing that their Report is as unsatisfactory in favor of a good cause, as in the goloid currency question it might have been fatally effective in a bad one.

As Mr. Culver, clerk to this committee, furnishes a short preface in which he speaks of the report as "compendious" and a "convenient book of reference," it is likely that he is responsible for it. None but the too partial eye of the editor could detect these qualities in a mosaic of which not a stone seems to have been fashioned to fit its place and all are put together without regard to form.

We have been informed that *only* 1200 copies of this report have been published, while 10,000 have been ordered by Congress. It is to be hoped that the other 8800 will not be issued until they have been completely revised and arranged so as to subserve some useful end, however small. At present the report may be compared to the last stanza in the "House that Jack built." Mr. Adams' (J. Q.) first report on the metric system representing the malt said to have lain in that house.

COUES'S BIRDS OF THE COLORADO VALLEY, PART I.[1] — Dr. Coues writings on ornithological matters have become so well known both to specialists and the public at large, that the promised advent of a book from his pen is looked forward to with no ordinary degree of interest.

The present volume, "Birds of the Colorado Valley," may be regarded as complementary to the "Birds of the North-west," and when the work is finished, for we are promised a second volume in continuation, we shall have from our author what may be considered, collectively, as a very complete treatise, both technically and biographically, of the birds of our western interior.

The volume is introduced with a prefatory note by Prof. Hayden, in charge, in which is briefly given the scope of the work and a general description of the area treated of, with allusions to its ornithological facies in its broader aspects, together with a graceful mention of the several authors and workers in the same field whose writings and labors have been most largely drawn upon by the author.

The volume is divided into convenient chapters, each treating of a single family and beginning with a concise enumeration of the family characters. The genera or sub-genera are next characterized with sufficient amplitude for all practical purposes, when follows the treatment, in greater or less detail, of each species.

If it be permissible to compare the method of handling the subject adopted here with that of the companion octavo, which was, at the time of its appearance, regarded as so admirable, the present volume loses nothing by the comparison. On the contrary its literary execution appears to have received more care

[1] *Birds of the Colorado Valley.* A Repository of Scientific and Popular Information concerning North American Ornithology. By ELLIOTT COUES. Part I.—Passeres to Laniidæ. Seventy illustrations. 8vo, pp. XVI, 807. Washington Government Printing Office, 1878. Miscellaneous publications of the U. S. Geological Survey of the Territories, F. V. Hayden, U. S. Geologist-in-charge.

and to demand even higher praise, while the descriptions of all the species introduced, with the generally more thorough manner of treatment, gives to the present book a far wider sphere of usefulness.

It is rarely given to one individual to wield the pen of the exact scientific writer and, in addition, to possess the light touch, the facility of expression, the graceful humorous fancy—in short, the happy way of putting things—that so preëminently characterizes Dr. Coues' writings. It is due to this more than anything else that our author enjoys such a widespread popularity, since not only do such books as the present have an acknowledged value to the working ornithologist, but their popular element renders them acceptable to a large circle to whom ordinary ornithological treatises possess little or no interest.

We notice, in passing, in not a few instances that Dr. Coues has done good service in supplying vernacular names to birds hitherto christened in Latin, and in replacing inappropriate or positively objectionable appellations by others of his own coining. In most cases his selections are apt and well chosen. In others they cannot be so strongly endorsed, as, for instance, when he imports the term "Accentor" from the continent and applies it to our water thrushes. Its original application was to a group of birds of very different character, and hence the same argument against it applies that has very properly been given weight in other instances, as the robin, quail, partridge and others, which names, as attached to our birds have no proper significance, to say nothing of the fact that our bird's familiar name of water thrush is sufficiently appropriate and descriptive.

The use of Bartramian names in a number of instances will probably not find favor in the eyes of some ornithologists. But here there is ground for honest differences of opinion, and the discrimination for or against their use, at least in certain of them, must be left to the judgment of each writer.

Dr. Coues has especially laid the student of North American ornithology under heavy debt in two particulars, first in the synonomy, and second in the bibliography of the present volume. Just how much is meant by the statement of a personal verification and settlement of synonomical points and references, and the amount of labor involved in such a work will probably be appreciated by the few workers in the same field—and the paragraphs, amounting in certain instances to pages of fine type, which precede each description, will probably be passed over by the general reader entirely unnoticed, or with a mere glance of wonder as to their purpose.

The closet worker, however, will here find much matter to be grateful for, and in consequence of the thorough manner in which it is here presented, will be saved many an hour of painstaking search in musty and uninviting old volumes. The collection of

synonomical lists involves many nice points in the settlement of which it is hardly to be expected there will be an unanimous opinion among naturalists, especially when a question of such prime importance as to what does or does not constitute a species is left practically to each author's own judgment, and hence, not infrequently, its settlement becomes simply a presentment of individual opinions, or merely an exponent of the amount of material on hand for comparison. Here our author's power of research and fine critical ability is well displayed, and we think that in the main his conclusions rest upon safe ground.

In other cases we believe his views will bear scrutiny, and may cite, as a possible instance of hasty conclusion on the part of the author, his statement that the *Petrochelidon fulva*, of the West Indies, is scarcely, if at all, distinct from our *P. lunifrons*. We are giad to notice that he has left the matter open for future investigation and final settlement, as we feel sure that direct comparisons of specimens will show that the two are entirely distinct, even on the least conservative grounds.

But most important of all must be deemed the bibliographical appendix which is simply a brief extract of the Universal Bibliography of Ornithology, which is now in the author's hands well advanced towards completion.

The student must regret, of course, that within the present covers is not contained a full presentation of all North American titles, and that the present could not thus be made a monograph of this part of the subject. But if the line had to be drawn somewhere, he may congratulate himself that he has here access to so much as ninety-five per cent. of the whole amount, for so large a proportion as this, as the author states, is here represented. The missing five per cent. consist of all monographs, all general treatises on the birds of larger geographical areas, even if including North America, and all general works on ornithology.

We miss a few titles that appear to us should be present, even under the limitations drawn for himself by the author. Thus we do not find Grinnell's List of the Birds of the Yellowstone National Park in Capt. Ludlow's Report of the Chief of Engineer's, 1876, and Henshaw's Report on the Ornithological Specimens of the Wheeler Expedition for 1872, '73, '74, both quartos and of considerable importance, as well as some others. But these must be looked upon as omissions of but trifling importance when we consider the admirable fullness of this bibliography within its prescribed limits. We should not omit to mention that a most excellent index, almost, in fact, a bibliography by itself, renders reference to any desired title an easy and expeditious matter. The bibliography if finished with the same painstaking care so evident in this extract, must stand as a monument of critical labor and as a model for all future work in the same direction.

Glancing at the press-work it is evident that much care has

been taken with the proof-reading with the result that very few typographical errors appear. The printing of the first eleven chapters (nearly) upon tinted paper in strong contrast to the white of the remaining pages, from no fault of the printer as we understand, is to be regretted. The critical eye in search of faults might notice too, upon many pages, traces of old and worn type. But as a whole, and especially as regards its exterior dress, the appearance of the volume is neat and pleasing, and leaves little to be desired.

A government report might be supposed to be the last place to which one would turn in search of matter to while away an idle hour, but our author contrives to introduce into his pages many a bit of pleasant philosophy and many a tale of birds and their doings that will prove to the appreciative reader anything else but dry reading. Like the skillful cook whose art is shown by his power to serve a juicy dish, be the meat never so tough and unsavory, so the author's skill as a writer is seen in his ability to dress up bird histories, however commonplace the subjects, in a style that is sure to please. For a choice example of his peculiar knack, let us refer the reader to his story of the familiar catbird, where the author appears to us in his happiest vein of humor.

But space forbids even mention of all the good things that are brought together within these covers. Let each of our readers who loves a good book send for a copy, and we predict that few indeed will turn its leaves without finding something which will appeal to his or her interest.—*H. W. H.*

JENSEN'S TURBELLARIAN WORMS OF NORWAY.[1]—Our marine zoölogists will be interested in the appearance of this valuable work on the marine flat-worms of the Norwegian coast. A number of new forms are described in considerable detail, with excellent figures, while the descriptive portion is preceded by quite full anatomical details. The work is done in the careful, conscientious manner characteristic of Scandinavian zoölogists. The descriptions are both in Latin and Norwegian, so that the work is accessible to students in general.

McCOOK'S NATURAL HISTORY OF THE AGRICULTURAL ANT OF TEXAS.[2]—For a number of years Rev. Mr. McCook, has been a diligent student of the habits of the ants of his own State, Pennsylvania, his papers appearing in the Proceedings of the Academy of Natural Sciences. The present volume is devoted to a single

[1] *Turbellaria ad Litora Norvegiæ occidentalia. Turbellarier ved Norges Vestkyst.* Af OLAF S. JENSEN, Conservator ved Bergens Museum. Mid 8 lithograferede tavler. Bergen, 1878. Folio, pp. 98.

[2] *The Natural History of the Agricultural Ant of Texas.* A Monograph of the Habits, Architecture and Structure of *Pogonomyrmex barbatus.* By HENRY CHRISTOPHER McCOOK. Author's edition. Academy of Natural Sciences of Philadelphia. Anno Domini, 1879. 8vo, pp. 310. 24 lithographic plates.

species, the agricultural ant of Texas, to which the attention of naturalists had been drawn by the late Dr. Lincecum, of Texas. This ant is preëminent, as the author states, for its admirable social organization, its skill as a mason in excavating its vast and well ordered system of underground chambers; its extensive surface operations in clearing out circular court-yards to its nests, and road-ways to its foraging grounds; the striking variations in its surface architecture from cones to flat disks; its highly developed stinging powers, which place it among the most formidable of the stinging ants; while it is especially noteworthy from its harvesting habits. The results of the energy, skill and patience evinced in the study of this ant are most successful. There is an honesty of purpose, thoroughness in detail and general accuracy of statement, together with fullness of illustration in the cuts and the twenty-four lithographic plates, which will give a lasting value to the book as a biography of one of the most interesting of all animals.

We wish the author had given us his impressions as to the nature of the instinctive and rational acts of the ant, but we have here a store-house of generally well observed facts, which will afford material for the future student of animal psychology. The drawings are mostly by the author, and add greatly to the interest and attractiveness of the book.

WATERTON'S WANDERINGS IN SOUTH AMERICA.[1]—This quaint, at times somewhat affected narrative, whatever its drawbacks when judged by the standard works of scientific travelers, has always had a hold upon general readers. It is the journal of an English country gentleman possessed with a strong love of nature, a decided leaning to ornithology, a genius for taxidermy, and withal a patient and generally accurate observer. There are scattered through the volume sketches of animal nature which give it permanent value. While Waterton's adventures with the Cayman are credible, despite his contemporary critics, we have to thank him for the attractive and truthful pictures of tropical scenery and life. His sketches of the ant bear, the armadillo, the vampire, the ai or three-toed sloth, of certain birds, of the natives among whom he traveled, and his researches on wourali poison are all as valuable as they are entertaining. In his description of the sloth, Waterton makes a contribution to the subject of protective resemblance. "I observed," he writes, "when he was climbing he never used his arms both together, but first one and then the other, and so on alternately. There is a singularity in

[1] *Wanderings in South America, the north-west of the United States and the Antilles, in the years* 1812, 1816, 1820 and 1824. With original instructions for the perfect preservation of birds, etc., for cabinets of natural history. By CHARLES WATERTON, Esq. New edition, edited, with biographical introduction and explanatory index, by the Rev. J. G. WOOD. With one hundred illustrations. London, Macmillan & Co., 1878. 8vo, pp. 520. $7.50.

his hair different from that of all other animals, and, I believe, hitherto unnoticed by naturalists; his hair is thick and coarse at the extremity, and gradually tapers to the root, where it becomes fine as a spider's web. His fur has so much the hue of the moss which grows on the branches of the trees, that it is very difficult to make him out when he is at rest."

The biography of Waterton by Rev. J. G. Wood, with its attractive illustrations, brings out well the characteristics of the hero of the narrative. The explanatory index by the editor occupies about one hundred and fifty pages, and has frequent illustrations. Taken altogether this edition is most attractive, and is a companion volume to Macmillan's elegant edition of White's Selbourne.

RECENT BOOKS AND PAMPHLETS.—The Devonian Brachiopoda of the Province of Pará, Brazil. By Charles Rathbun, late assistant geologist to the Geological Commission of Brazil, Prof. C. F. Hartt, chief. (From the Proceedings of the Boston Society of Natural History, XX, May 15, 1878.) 8vo, pp. 39.

Evidences of Cannibalism in an early race in Japan. By Edward S. Morse. (Reprinted from the Tokio Times, Jan. 18, 1879.) Tokio, Japan, 1879. 8vo, pp. 7.

Phryganiden-Studien. Von Fritz und Hermann Müller. (Kosmos II. Jahrg. Heft II.) 8vo, pp. 386–396.

A Treatise on the Horse and his diseases, etc. By B. J. Kendall. Claremont, N. H., 1878. 12mo, pp. 89.

Crustacea Cumacea of the "Lightening," "Porcupine" and "Valorous" Expeditions. By the Rev. A. M. Norman. (From the Annals and Magazine of Natural History, Jan, 1879.) 8vo, pp. 19.

On Loxosoma and Triticella, genera of semi-parasitic Polyzoa in the British Seas. By the Rev. A. M. Norman. (From the Annals and Magazine of Natural History, Feb., 1879.) 8vo, pp. 7.

Geological Survey of New Jersey. Annual Report of the State Geologist for the year 1878. 8vo, pp. 131, with map. Trenton, N. J., 1878. From the author.

Fourteenth Annual Report of Rutgers Scientific School, the State College for the benefit of Agriculture and Mechanic Arts, New Brunswick, N. J., for the year 1878. 8vo, pp. 89. From the College.

A Synopsis of the American Firs (*Abies* Link). By Dr. George Engelmann. (Ext. from the Trans. Acad. of Sciences of St. Louis, Vol. III No. 4; read Dec. 17, 1877.) 8vo, pp. 10. St. Louis, Mo., 1878. From the author.

The Flowering of Agave shawii. By Dr. George Engelmann. (Ext. from Trans. Acad. Sciences, St. Louis, Vol. III, No. 4.) 8vo, pp. 4. with plate. (Nov., 1877.) From the author.

The American Junipers of the Section Sabina. By Dr. George Engelmann. (Ext. from Trans. Acad. Sciences, St. Louis, Vol. III, No. 4.) 8vo, pp. 10. (Nov., 1877.) From the author.

The Species of Isoetes of the Indian Territory. By Dr. G. Engelmann, St. Louis, Nov., 1877, with note by G. D. Butler, Almont, Iowa. (Ext. from Botan. Gaz. Vol. 3, No. 1, 1878.) From the author.

The Oaks of the United States (continuation). By Dr. George Engelmann. (Ext. from Trans. Acad. Sciences, St. Louis, Vol. III, No. 4, read Oct., 1877.) 8vo, pp. 21, with separate index. St. Louis, Nov., 1878. From the author.

The Annual Medical Directory of Regular Physicians in the State of Illinois, including all those who have complied with the law by registering in the office of the State Board of Health; for the year 1878. F. A. Emmons, M.D., editor. 8vo, pp. 112. Chicago, 1878. From the author.

Inscribed Stone of Grave Creek Mound. Report on—by M. C. Reid, of Hudson, Ohio, read at the meeting of the State Archæological Society, held at Wooster, Ohio, Sept. 25, 1878. (Ext. Am. Antiquarian, Vol. 1, No. 3.) 8vo, pp. 139–149. From the author.

Note sur le bassin tertiaire de Bahna (Roumanie). Par M. Stephanesco. (Ext. du Bull. de la Soc. Géol. de France. 3e Série, to. v, pp.387–293. Séance du 19 Mars, 1877.) 8vo, with plate. From the author.

Jura-Trias Section of South-eastern Idaho and Western Wyoming. By A. C. Peale, M.D. (Ext. from the Bull. of the U. S. Geol. and Geog. Surveys, Vol. v, No. 1.) 8vo, pp. 119 123. (Washington, Feb. 28, 1879.) From the author.

Classification of Coals. By Persifor Frazer, Jr., Philadelphia. (Ext. from Trans. Am. Inst. of Mining Engineers, Vol. vi, read at the Wilkesbarre meeting, May, 1877.) Author's edition, 1879. From the author.

On the Structure of the Gorilla. By Henry C. Chapman, M.D. (Ext. Proc. Acad. Nat. Sciences, Phila., 1878.) 8vo, pp. 385–394, pls. III–VI. From the author.

Fossil Forests of the Volcanic Tertiary Formations of the Yellowstone National Park. By W. H. Holmes. (Ext. from the Bull. of the U. S. Geol. and Geog. Survey, Vol. v, No. 1). 8vo, pp. 125–132. (Washington, Feb. 28, 1879. From the author.

On the Association of Dwarf Crocodiles (*Nannosuchus* and *Theriosuchus pusillus*, e. g.), with the Diminutive Mammals of the Purbeck Shales. By Prof. Richard Owen, C.B., F.R.S., F.G.S. (Ext. from Quart. Journ. Geol. Soc., London, Feb., 1879.) 8vo, pp. 148–155, with plate. From the author.

A Catalogue of Official Reports upon Geological Surveys of the United States and Territories, and of British North America. By Frederick Prime, Jr., Assistant Geologist of Pennsylvania. 8vo, pp. 51. (Proof copy.) Philadelphia. March 15, 1879. From the author.

Catalogue of the Birds collected in Martinique, by Mr. Fred. A. Ober, for the Smithsonian Institution. By Geo. N. Lawrence. (Ext. Proc. U. S. National Museum.) 8vo, pp. 349–360. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia. Part III, 1878. 8vo, pp. 329–475, plf. III–VI. Philadelphia, 1879. And the same, pp. 9–24, of the volume for 1879. From the society.

Richthofen's Theory of the Loess, in the light of the Deposits of the Missouri. By J. E. Todd, of Tabor, Iowa. (Ext. from Proc. Am. Asso. Adv. of Science, Vol. XXVII. St. Louis meeting, Aug., 1878.) 8vo, pp. 10. From the author.

The Engineering and Mining Journal (Miniature copy). 12mo. No. 25 of Vol. XXVI. New York, Dec. 21, 1878. From the editor.

Boletin del Ministerio de Fomento de la Republica Mexicana. Folio (Daily) from March 13, to Feb. 20, 1879. From the Director of the Central Meteorological Observatory.

Proceedings of the National Academy of Sciences for 1878. 8vo, pp. 125–142. From the Academy.

Chesapeake Zoölogical Laboratory, Johns Hopkins University, Baltimore, Md. Scientific Results of the Session of 1878. (June 24th to Aug. 19th.) 8vo, pp. 190, pls. 13. Baltimore, John Murphy & Co., 1879. From the University.

Sur les Reptiles du temps primaires. Par M. Alb. Gaudry. (Ext. from Comptes Rendus de l'Academie des Sciences, 16 Decembre, 1878.) 4to, pp. 3. From the author.

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GENERAL NOTES.

BOTANY.

Instinct and Reason, by F. C. Clark.—"Wonders of the vegetable world" never cease. Some of them are brought to light in the pages of the February number of the American Naturalist. "Leaves often change to roots, and roots in favorable

circumstances become leaves." "The plant * * * for reproductive purposes has nettles, thorns, elastic films, as in the seed vessels of the squirting cucumber." "If the well-known sensitive plant be touched never so lightly, its flowers and leaves close." "The 'resurrection plant,' generally known as the Rose of Jericho * * * * to all appearance a mass of dry, dead vegetable fibre * * * when sufficient moisture is applied it revives, its leaves expand, it is clothed in new verdure, and as its blossoms unfold, the reanimated plant is clothed in all its former beauty." "When night approaches flowers close their petals * * * * * some plants, however, only flower at night. The beautiful Yuccas a species of wild lily, only blossom when the moon is out." The small leaflets of *Desmodium gyrans* "move up and down in alternate jerks, at the rate of sixty a minute. * * * This motion is continued during all the seasons of the year, and during the whole life-time of the plant."

For all but one of these wonders the authority cited is "Wonders of the Vegetable World, by Schele DeVere." This book we believe to be a second edition of one entitled A Salad for the Solitary, which was noticed in the *American Journal of Science and the Arts* a good many years ago. It was then remarked that "Ignorance is not a sin *per se*, its heinousness depends on the use that is made of it." The following wonders, like that of the blooming of the Yuccas in moonlight, are more original, or at least more modern. In *Darlingtonia californica* "beautiful red wattles within the brim of its pitcher offer irresistible attractions to insects, especially to flies. These alight first upon the 'wattles,' then flying upward strike the pitcher, and owing to the peculiar twist of its walls falls to the bottom of the receptacle, where many another thoughtless fly has, too late, found its sepulchre." Why too late?

"Mrs. Treat has studied the habits of this plant (bladder wort, *Utricularia neglecta*), and learned that it allures animalcules by means of its bright flowers and leaves glistening with dew."

Some sentences are wondrous in other ways: *e. gr.* "For the removal of obstacles the plant has two courses, to disintegrate the object opposed to its progress, absorbing it if it be a suitable nutritive element, as are all animal and vegetable substances, and some minerals, or pass around it; or still again, as in extreme cases, to bury it up in its own substance, as are stones, bayonets, nails and the like."

Now a popular article, when it touches upon subjects of which the writer knows little or nothing, should be judged forbearingly when it goes wildly astray. In an ordinary magazine it would matter little, but in the pages of the AMERICAN NATURALIST these statements gain an importance and a currency which is not altogther pleasant. The undersigned does his duty in simply calling attention to the matter.—*Asa Gray.*

Henslow on the Self-Fertilization of Plants.—The Rev. George Henslow concludes from his studies on the structure of plants, that the prevailing views as to the necessity of cross-fertilization are too extreme. He claims that "Mr. Darwin's works have gone too far to strengthen the belief that intercrossing is absolutely necessary for plants; and that if self-fertilization be continued for lengthened periods the plants tend to degenerate and thence to ultimate extinction. This I believe to be absolutely false." Mr. Henslow arrives at the following conclusions in his article in the Popular Science Review: "1. The majority of flowering plants can, and possibly do, fertilize themselves. 2. Very few plants are known to be physiologically self-sterile when the pollen of a flower is placed on the stigma of the same flower. 3. Several plants are known to be morphologically self-sterile in that the pollen cannot, without aid, reach the stigma, but is effective on that of the same flower. 4. Self-sterile plants from both the above causes can become self-fertile. 5. Highly self-fertile forms may arise under cultivation. 6. Special adaptations occur for self-fertilization."

Contraction of Leaves of Sensitive Plants.—In Sir J. D. Hooker's recent address as President of the Royal Society, it is stated that Dr. Burdon Sanderson has for two years past been stüdying the true relations between the electrical disturbances followed by the shutting of the leaf valves of Dionæa, and the latent change of protoplasm which precedes this operation. He has found that though the mechanism of the change of form of the excitable parenchyma which causes the contraction is entirely different from that of muscular contraction, yet that the correspondence between the exciting process in the animal tissues and what represents this in the plant tissues appears to be more complete the more carefully the comparison is made; and that whether the stimulus be mechanical, thermal, or electrical, its effects correspond in each case. Again, the excitation is propagated from the point of excitation to distant points in the order of their remoteness, and the degree to which the structure is excited depends upon its temperature. Notwithstanding, however, the striking analogies between the electrical properties of the cells of Dionæa and of muscle-cylinders, Dr. Burdon Sanderson is wholly unable to admit with Prof. Munk that these structures are in this respect comparable.

ZOÖLOGY.[1]

Discovery of Male Eels.—We are glad to state that finally what we believe to be genuine male eels have been discovered. In the January number of this journal it was announced by Prof. Packard that he had discovered male eels. A number of the supposed males were afterward again examined, by Prof.

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

Packard and Dr. C. S. Minot, who were then led to conclude that the so-called male eels were immature females, and the mistake was corrected by Prof. Packard in the February NATURALIST. A large number of living eels were then examined by Messrs. Packard, Kingsley, Pierce and Minot without success, until at Prof. Packard's request Mr. Kingsley spent a few days at Wood's Holl, at the laboratory of the U. S. Fish Commission, in the last of February, examining living eels supplied by Mr. Vinal N. Edwards, by favor of Prof. Baird, U. S. Fish Commissioner. One hundred and ninety-three eels were there examined, and of these, three were found by Mr. Kingsley to be, in his opinion, males. His observations made on these living individuals, which were speared in a pond through the ice, are as follows:

"On February 18, 19 and 20, I examined one hundred and ninety-three eels, at Wood's Holl, and found three males, the testes of which agreed closely with Syrski's figures as reproduced in the U. S. Fish Commission Report for 1873–4 and 1874–5, p. 719. Although I made careful examination I could find no external characters to separate the sexes. The three males were each about seventeen inches long, while the females examined varied from about twelve inches to nearly three feet. This average length of males agrees closely with Syrski's (430 mm. in length). The principal criticisms I would make of his figures, or rather points of difference that I found, are that his enlarged figure showing the lobulation of the testis has the lobes far more crowded than they were in the specimens I examined. His drawing of the histological structure was greatly larger than what I supposed to be the same. His cells measure, according to the explanation, about $\frac{1}{440}$ of an inch on their major axis, while I saw nothing that could have been over $\frac{1}{4000}$ of an inch. The structure of the testis was similar to that which I have seen in the testes of the cod, perch, smelt, cat, deer, rooster, monkey, dog and man. On teasing it out under a Tolles one-fifth, I saw what I am confident were spermatozoa, although I could not distinguish the tails. The heads were oval and from one-half to one-third the size of those of the smelt, or about $\frac{1}{50000}$ of an inch in length; they had an independent motion, changing their position on the slide without reference to any current in the water in which the tissue was placed, and this motion was wholly different in its character from the vibrations of the Brownian movement."

Prof. Packard examined independently of and in company with Mr. Kingsley, preparations made by himself, and found scattered through the tissues, nucleated and nucleolated testis cells, of the same appearance as those of the animals above named, which were kindly obtained by Prof. Pierce. Moreover, Prof. Packard found two mother-cells, containing several immature nucleated spermatozoa. So that after the examination of about five hundred female eels and three males, we are glad to be able to affirm

the entire accuracy of Syrski's observations and figures, he being the first observer, so far as we are aware, who has discovered the male sex of the Italian eel. Which species of eel it was that Syrski examined is not stated. In making these investigations we have to acknowledge the aid of Prof. John Pierce, of Providence, in the use of a fine series of mounted histological specimens and lenses of high powers. He has worked jointly with us and is of our opinion as to the sex of the three males. Dr. Minot examined one of the three males, preserved in alcohol, and found as Freud and Brock had done previously, a folliclular structure, the follicles being filled with small spherical cells, which Dr. Minot considered to be probably immature spermatozoa, although the development could not be traced.—*A. S. Packard, Jr., and J. S. Kingsley.*

Breeding Habits of the Dace.—In the early part of June, 1878, an excellent opportunity offered itself for observing the breeding habits of the dace (*Rhinichthys atronasus*). Standing one afternoon upon one of the bridges crossing the river in this city, a nest of this fish was discovered in the stream below, it was about two feet in diameter, situated in running water from twelve to fifteen inches deep, and protected upon the upper side by a small root by which the current of the water was broken. The female would pass over the pebbles and deposit her spawn, while the male stood ready for an attack, and on the approach of an enemy would dart off like a flash in pursuit of the intruder. When no danger was near, and after the bed had been covered with spawn, the female would stand sentry until the male had passed over the eggs, and then both would proceed up the stream from four to ten feet or more, and taking a small pebble in their mouths, would quickly return and deposit them on the fecundated eggs, sometimes but one fish would go for pebbles, the other lingering near, thus layer after layer of impregnated eggs and pebbles were deposited one upon the other. These movements were watched for two days, when the water became muddy from the spring rains, and further observation was impossible. The wisdom displayed in these operations, and the wonderful exhibition of the instinct for the preservation of species is readily seen. The covering of the eggs retained them in their place, and at the same time protected them from being destroyed by other fishes who were constantly hovering about, like vultures watching an opportunity to devour them, while the interstices between the pebbles gave sufficient space to harbor the little *fry*, as soon as hatched, and to protect them until they, by their own instincts or by the assistance of the parent fish, were able to seek shelter beyond the reach of their enemies. I have no doubt in this manner all fresh-water *oviparous* fish deposit their spawn in (*not upon*) the pebble heaps we call their nests.—*W. H. Gregg, M.D., Elmira, N. Y.*

Large Rattlesnakes.—Col. T. M. Bryan, of Vincenttown, N. J., writes us under date of Aug. 16th, that, " Rattlesnakes are very numerous with us just now, on account of the large amount of cedar swamp which is being cut. I obtained one which was six feet two inches long, with fourteen rattles and a button. Within the ensuing five days seven were offered, none, however, as long as the above mentioned, but one was five feet nine inches, and had fifteen rattles and a button."

Sound-producing Organs of the Cricket.— During some researches among the order of Orthopters, made by me the past fall, I made it a point to carefully investigate the means by which the stridulous calls of the family Saltatoria were produced. Latreille, in the " Animal Kingdom " of Cuvier, says of this family of leapers: " The males call their females by making a chirping noise, which is sometimes produced by rubbing an inner part of the wing-covers like a talc-like mirror, against each other with rapidity, and sometimes by a similar alternate motion of the hind thighs against the wings and wing-covers, the thighs acting the part of the bow of a violin." This description may be considered

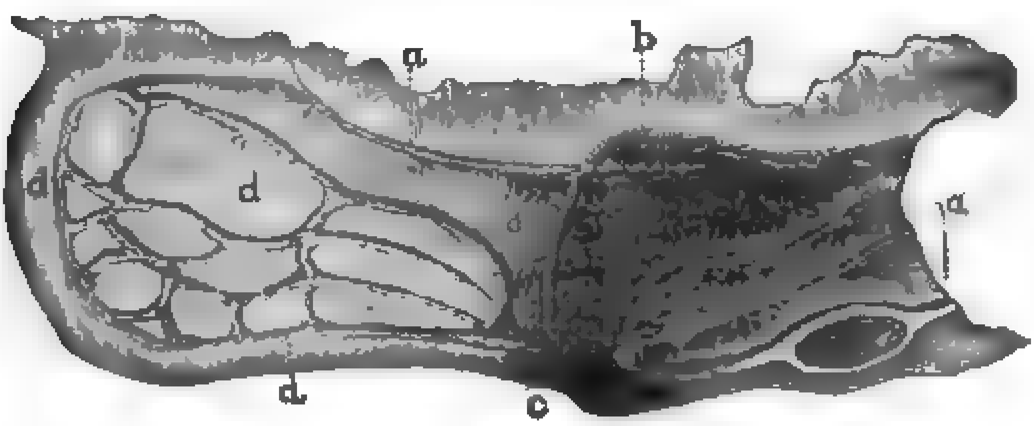


Fig. 1—Enlarged view of the under side of the wing-case of cricket; *a, a,* tracheal tube; *b,* ridge bearing vibratory flanges; *c,* slight protuberance; *d,* coriaceous membrane.

as relating more especially to the group in general, but in the case of the genus *Gryllus* (*Acheta* of English authors), of which I propose to speak, there is a special arrangement, a singular adaptation of means to ends.

It must be evident to all who are familiar with the notes produced by the cricket, that the extreme shrillness and penetrating power of their call could with difficulty be produced by the simple frictional movement of one unctuous " talc-like " surface over another. There are many different species the calls of which can be heard at the distance of several hundred feet, and one species, inhabiting Sicily (*G. megacephalus*) whose call has been distinguished at the distance of a mile.

This power to produce a penetrating tone, calls for a special

arrangement for that purpose. This arrangement we find on the under side of the wing-cases.

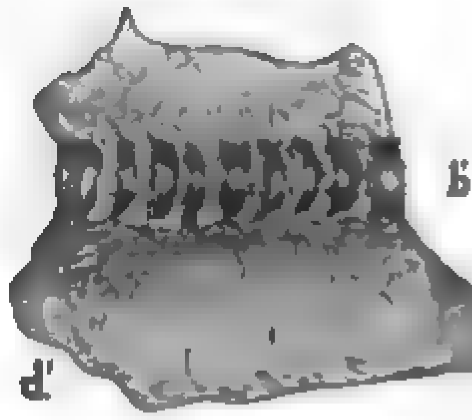


Fig. 2—*b'*, more enlarged view of the vibratory flanges; *d'*, scaly leather like membrane.

From a protuberance on the under-side of the coriaceous wing-case, about one-third the length of the case from its anterior extremity, and situated on the inner or sutural edge, there is a large tracheal tube which extends out laterally, thence forward and terminates at the juncture of the wing-case with the thorax. This tracheal tube forms, or extends through a ridge on the inferior surface of the case, which is in the form of a quadrant or crescent. On the ridge is situated a series of minute transverse vibratory flanges, resting upon edge and resembling, to a certain extent, the scales of a fish when scraped so as to cause them to stand erect. The base of each flange is thickened, the upper edge slightly blunted and recurved. The upper surface of the wing-case is squamous, so that when either case is drawn over the other, the series of vibratory flanges on the under side of one is made to pass rapidly over the scaly upper surface of the underlying case, in this manner producing the harsh creaking sound so familiar. By a greater or less rapidity of motion the insect can produce the variations of tone which are often observed. As the cases do not unite in the center of the back but each passes nearly to the opposite side of the body, the chain of vibratory flanges can be utilized to nearly its full length, before it becomes necessary to re-commence the stroke.

When the ring-cases are at rest the two crescent shaped ridges are united so as to inclose a semicircular space in the center of the anterior portion of the cases. The leathery covering of this space is slightly elevated, forming a chamber underneath, which prevents the sound from being smothered in the folds of the second pair of wings, which lie directly beneath. The insect when about to produce its call usually assumes a fixed, statue-like position, with head lowered and posterior extremities slightly elevated, the cases forming an angle of twenty or thirty degrees with the abdomen.

The call is formed during the outward stroke of the cases, they being slightly separated when returning to the first position. I noticed that the field species, when calling from the mouth of its abode, stood with the head in the burrow and the extremities of the wings protruding from the opening, thus seeming to comprehend that their call could be heard to a greater distance if standing in this position than if in the reversed.

I have examined the wing-cases of a number of species and find that they all have a like arrangement to the one here described, although the shape of the flanges may vary, to a certain extent.—*Newton B. Pierce.*

THE LECANIUM OF THE TULIP TREE.—On page 218 of the "Revised Manual," in speaking of other sources than flowers from which bees collect sweets, I remark that I have seen the bees thick about a large bark-louse, which attacks and often destroys one of our best honey-trees. This is an undescribed species of the genus Lecanium.

In the summer of 1870 this louse, which, so far as I know, has never yet been described, and for which I propose the name *Lecanium tulipiferæ*—the Lecanium of the tulip tree—was very common on the tulip trees about the lawns of the Michican Agricultural College, at Lansing. So destructive were they that some of the trees were killed outright, others were much injured, and had not the lice, for some unknown reason, ceased to thrive, we should soon have missed from our grounds one of our most attractive trees.

Since the date above given, I have received these insects from many of the States, especially those bordering the Ohio river. In Tennessee they seem very common, as they are often noticed in abundance on the fine stately tulip trees of that goodly State. In the South this tulip tree is called the poplar, which is very incorrect, as it is in no way related to the latter. The poplar belongs to the willow family; the tulip to the magnolia, which families are wide apart.

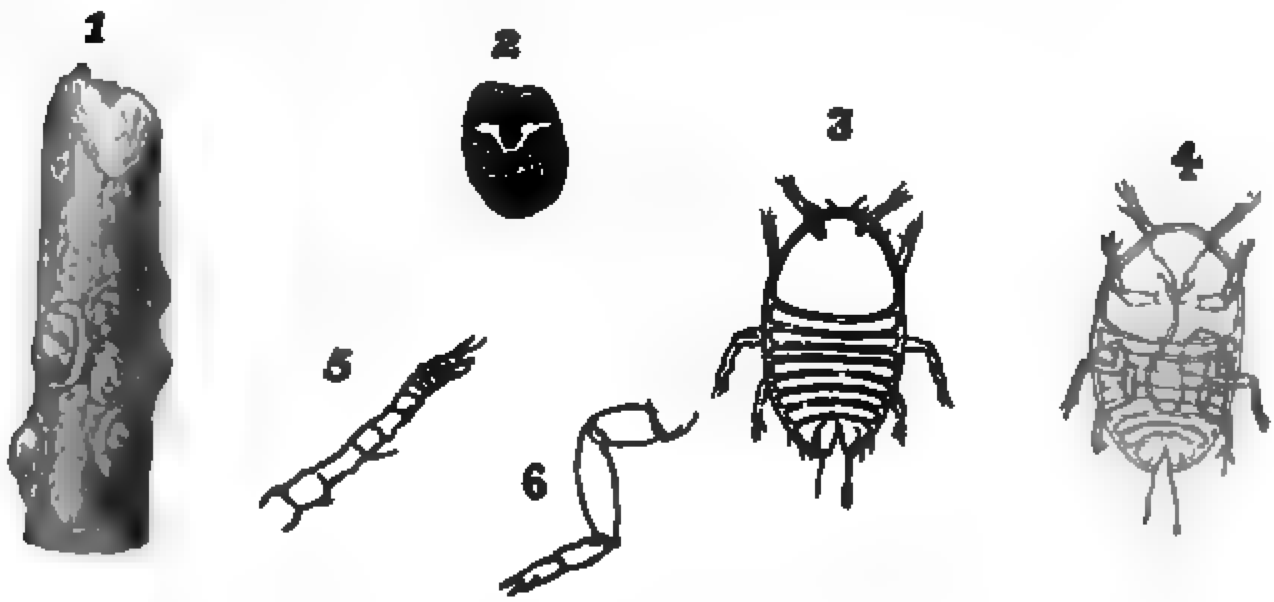
Wherever the tulip-tree lice have been observed, sucking the sap and vitality from the trees, there the bees have also been seen, lapping up a sweet juicy exudation which is secreted by the lice. In 1870 I observed that our tulip trees were alive with bees and wasps, even as late as August, though the trees are in blossom only in June. Examination showed that the exuding sweets from these lice were what attracted the bees. This was observed with some anxiety, as the secretion gives off a very nauseating odor.

The oozing secretions from this and other lice, not only of the bark-louse family (Coccidæ), but of the plant-louse family (Aphidæ), are often referred to as honey-dew. Would it not be better to speak of these as insect secretions, and reserve the name honey-dew for sweet secretions from plants, other than those which come from the flowers?

The fully developed insect, like all bark lice, is in the form of a scale (Fig. 1), closely applied to the limb or twig on which it works. This insect, like most of its genus, is brown, very convex above (Fig. 1), and concave beneath (Fig. 2). On the under side is a cotton-like secretion, common to all of the genus Lecanium, which serves to enfold the eggs. Underneath the species in question are two transverse parallel lines of this white down (Fig.

2). One of them, probably the anterior, is nearly marginal, and is interrupted in the middle, while the other is nearly central, and in place of the interruption at the middle, it has a V-shaped projection back or away from the other line. The form of the scale is quadrangular, and not unlike that of a turtle (Fig. 1). When fully developed it is a little more than three-sixteenths of an inch long, and a little more than two-thirds as wide.

Here at Lansing, the small, yellow, oval eggs appear late in August. In Tennessee they would be found under the scales in their cotton wrappings many days earlier. The eggs are one-fortieth of an inch long, and one-sixty-fifth of an inch wide. These eggs, which are very numerous, hatch in the locality of



their development, and the young or larval lice, quite in contrast with their dried, inert, motionless parents, are spry and active. They are oval (Figs. 3 and 4), yellow, and one twenty-third of an inch long, and one-fortieth of an inch wide. The eyes, antennæ (Fig. 5) and legs (Fig. 6) are plainly visible when magnified thirty or forty diameters. The nine-jointed abdomen is deeply emarginate, or cut into posteriorly (Fig. 3), and on each side of this slit is a projecting stylet or hair (Figs. 3 and 4), while from between the eyes, on the under side of the head, extends the long recurved beak (Fig. 4). The larvæ soon leave the scales, crawl about the tree, and finally fasten by inserting their long slender beaks, when they so pump up the sap that they grow with surprising rapidity. In a few weeks their legs and antennæ disappear, and the scale-like form is assumed. In the following summer the scale is full-formed and the eggs are developed. Soon the scale, which is but the carcase of the once active louse, drops from the tree, and the work of destruction is left to the young lice, a responsibility which they seem quite ready to assume.

In my observations I have detected no males. Judging from others of the bark-lice, these probably possess wings, and will never assume the scale form, though Prof. P. R. Uhler writes me

that apterous males are found among the Coccidæ, and that in all cases the males are very important in the determination of genera.

Remedies.—If valued shade or honey trees are attacked by these insatiate destroyers, they could probably be saved by discrete pruning—cutting off the infected branches before serious injury was done, or by syringing the trees with a solution of whale-oil soap—or even common soft-soap would do—just as the young lice are leaving the scales. It would be still better to have the solution hot. Whitman's Fountain Pump is admirable for making such applications.

Fig. 1 is slightly magnified; the others are largely magnified. The drawings were made from the objects by W. S. Holdsworth, a senior of the Michigan Agricultural College.—*A. J. Cook.*

MOLTING OF THE HORNED TOAD (*Phrynosoma douglassi* Gray).—This well-known species of horned lizard, or horned toad as it is more commonly known, is very widely distributed over the north-western portion of the United States. It appears especially abundant throughout the Bad Lands, and over the dry country between the Yellowstone and Musselshell rivers. During my visit to those regions with the Yellowstone Expedition of 1873, about fifty specimens were collected for the purpose of studying some of their habits. The first were met with in the Bad Lands during the first week in July, where a number of young were obtained, having probably been born about the middle of June, as indicated by their size and condition. After the main body of the expedition had crossed the Yellowstone river, a temporary camp was established, when quite a number of adult specimens were obtained upon which we discovered the first signs of molting. Those which had been collected a few days before now began to show similar evidences of shedding the skin. At first, small dry vesicles made their appearance over the back and sides, running along the horizontal rows of pyramidal scales forming the margins of the abdomen. In a day or two the vesicles would break and desquamation began, which continued over a period of about eight or ten days, the cephalic spines and the claws being the last to adhere. Immediately after the old skin had been removed, the process of which I assisted in several instances as far as possible, the new surface presented quite a brilliant appearance when closely viewed. The darker markings upon the dorsum appeared minutely sprinkled with black and brick red, while the lighter portions remained a pure olive of various shades.

After molting, the intensity of coloration is gradually lost, as the skin becomes more ashy or dusky, returning to the natural hue which the specimen bore previous to molting.

The specimens as far as observed, went through the process of molting from three to four weeks after the birth of the young. Mr. H. W. Henshaw (Surveys west of 100th meridian) has

observed the change, but from his observation he thought it occurred during the breeding season.

The specimens found on the prairie region flanking the Yellowstone river, were very light in color; those from the Bad Lands somewhat darker, while those obtained near, and on the Mussel-shell river were extremely dark, and one specimen was nearly black. In this individual the abdomen was darker than the backs of the specimens from the prairie districts. The abdominal scales were densely covered with black spray, sufficiently so as to give some of them a uniform color.

Dr. Yarrow[1] and Mr. Henshaw both say the coloration of the animal depends greatly upon the color of the soil where found, and this has been the result of my observations in Dakota and Montana, as well as in Arizona among other species of the same genus.

Dr. Yarrow[2] in speaking of the time that these reptiles may be kept alive without food, says he has never been able to keep them alive over four months. Of the total number collected in 1873, I brought sixteen to Pennsylvania, five of which survived until the following May. The state of torpidity which began in December may account for this to some extent, but at various times during the winter of 1873–4, I placed them near the heater to revive them temporarily for the purpose of showing them to inquisitive visitors; still this did not apparently affect them. In May, 1874, I placed them in the garden, and soon after being exposed to the sun they showed signs of exhaustion, difficulty of respiration, and finally died. They were considerably emaciated, and probably the state of debility, in addition to a humid atmosphere and sudden exposure to the hot rays of the sun was too much for them.—*W. J. Hoffman, M.D.*

ANTHROPOLOGY.[3]

PERFORATED SKULLS.—Rev. Stephen Bowers, Ph.D., recently discovered a burial place near Santa Barbara. Cal., which he explored in part. It yielded thirty or forty skeletons, serpentine bowls, a pipe, arrow-head, shell and bone ornaments, beads, etc. But the most singular feature was a nest of six skulls entirely separated from the other portions of the body, and buried under bowlders and fragmental rocks; five of these skulls were perforated near the apex (with one exception); the perforations were about three-fourths of an inch in diameter, and were doubtless made at death. He found other perforated skulls in the same cemeteries, but they were in too friable a condition for preservation.

ETHNOLOGY OF SOUTHERN CALIFORNIA.—Dr. Bowers spent several months during the year 1878 in ethnological explorations

[1] Bull. U. S. Geol. and Geog. Survey, IV, 1878, p. 286.
[2] Ibid, p. 287.
[3] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

[illegible] Santa Barbara [illegible] and Ventura [illegible] Santa Maria [illegible] of their tribu- [illegible] mapped. In [illegible] of the early [illegible] remarkable [illegible]

[illegible]

[illegible]

[illegible] Mr. W. Flinders Petrie discusses the [illegible] of Metrology and Geometry in Ancient Remains [illegible] upon this subject [illegible] builders of [illegible]

[illegible]

permanent works have had a standard, and it is very difficult to ascertain what that standard was. Mr. Petrie finds a strong resemblance between the unit of the North American mound-builders and some of the old world standards.

The next paper on the game of Patolli, in Ancient Mexico, and its probable Asiatic origin, by Mr. E. B. Tylor, has already appeared in the *Popular Science Monthly*. The paper by Mr. Francis Galton on Composite Portraits was read last summer before the British Association, and was fully noticed at the time. The next communication, on the Origin of the classificatory system of relationship used among primitive peoples, by Mr. C. Staniland Wake, occupies 36 pages, and is chiefly a review of Mr. Lewis H. Morgan, Sir John Lubbock and Mr. McLennan, and opposes Mr. Morgan's hypothesis of the consanguine family and promiscuity as the starting point of his system. Mr. Wake affirms that "the consanguine family has not existed as a recognized social institution," and that "the Punaluan group can be accounted for satisfactorily without assuming the prior existence of the consanguine family." Against Sir John Lubbock's theory that "Children were not in the earliest times regarded as equally related to their father and their mother, but that the natural progress of ideas is, first, that a child is related to his tribe generally, secondly, to his mother and not to his father, thirdly, to his father and not to his mother, lastly, and lastly only, that he is related to both," Mr. Wake offers the opposing statements of Mr. Morgan with reference to our own American tribes. Mr. McLennan's system of polyandry is dismissed with a few words.

The number closes with two papers, by Mr. Alfred Simson, on South American tribes, entitled: "Notes on the Piojes of the Putumayo," and "Vocabulary of the Zaparo language."

All lovers of excellent work will be delighted with a new serial whose first number appeared Jan. 31, 1879, bearing the following title, *Index Medicus*, a Monthly classified record of the Current Medical Literature of the World. Compiled under the supervision of Dr. John S. Billings, Surgeon U. S. Army, and Dr. Robert Fletcher, M.R.C.S., Eng. New York, F. Leypoldt, 37 Park Row. We take the liberty to quote from page 31 the following titles:

Busch (H.) Grösse, Gewicht und Brustumfang von Soldaten. Studien über ihre Entwickelung und ihren Einfluss auf die militärische Tauglichkeit. Berlin, 1878, A. Hirschwald. 85 pp., 8vo.

Cassanova (A.) Ibridismo in ispecie fra l'uomo e parecchi animali, facendo punto sulla transformazione delle razze scimiotiche di primo ordine nelle infime selvaggie umane, e sui metodi per ottenere migliori tipi umani, equini, boviné, ovine, ecc. Milano, 1878. Zanaboni, 228 pp., 8vo, 5l.

Von Lenhossék (Jos.) Des déformations artificielles du crâne en général, de celles de deux crânes macrocéphales trouvés en

Hongrie et d'un crâne provenant des temps barbares dù meme pays. Avec 11 fig. phototyp. sur 3 planches, 11 fig. xylogr. et 5 fig. zincogr. intercalées dans le texte. Budapest, 1878, Kilian, 134 pp. gr. 4. m. 18.

Montano. Etude sur les crânes boughis et dayaks du Museum d'histoire naturelle. Avec projections au diagraphe intercalées dans le texte. Paris, 1878, G. Masson. 71 pp., 8vo.

Schoebel (C.). L'âme humaine au point de vue de la science ethnographique; suivi d'une note sur Claude Bernard et son principe du critérium ethnographique. Paris, 1878, De Rosny. 24 pp., 8vo.

Bouchut (E.). Peso de los recien nacedos. Rev. de med. y cir. práct., Madrid, 1878, II, 289–300.

Davreux. Un cas remarkable de microcéphalie. Ann. Soc. Med.—Chir. de Liege 1879, XVII, 329–331.

Dupouy. De l'hérédité et des mariages consanguins. Médecin, Par., 1878, IV (No. 40).

Whitley (N.). Is "palæolithic man" a reality of the past, or a myth of the present? Jour. of Psych. Med., London, 1878, n. s. IV, 256–275.

In addition to the foregoing valuable list from *Index Medicus*, the following brief references are given with the hope that they may be of service to some of our readers:

A review of non-Biblical Semitic literature for 1878, by A. Neubauer, in *Athenæum*, Jan. 11.——The Aryan Household: an Introduction to comparative jurisprudence, by William E. Hearn, reviewed in *Athenæum*, Jan. 25.——The History of Afghanistan from the earliest period to the outbreak of the war in 1878, by Col. G. B. Matteson, reviewed in *Academy*, Jan. 11.——Russian and Turk, from a geographical, ethnological and historical point of view, by R. G. Latham, reviewed in *Academy*, Jan. 18th, by M. Elie Reclus.——Discoveries of Antiquities in Italy in 1878, by F. Barnabei, reviewed in *Academy*, Jan. 18, 1879.——Prehistoric Copper Implements. An open letter to the Historical Society of Wisconsin, by Rev. E. F. Slater, *New England Hist. and Gen. Register*, Jan. 9, 9 pp.——Ancient Artificial Mounds, B. Shipp, *Louisville Magazine*, Jan., 7 pp.——Peruvian Antiquities, Dr. E. R. Heath, *Quarterly Journal of Science*, Jan.——Fairy Lore of Savages, J. A. Farrer, *Saturday Magazine*, Jan. 4, 8 pp.——The Indian as a coming citizen, by E. B., *Lippincott's Magazine*, Jan., 2 pp.

GEOLOGY AND PALÆONTOLOGY.

Geological Survey of New Zealand.—The following districts of New Zealand have been geologized during the season 1877–8: The Hokanui mountains in Southland, by Mr. Cox, from October to January, assisted by Mr. McKay, who continued the work of collecting fossils until the end of February. In January Mr. Cox visited and reported on the copper lode at Dusky sound.

He was then occupied until March in the examination of the Te Anau Lake district, after which he made the required inspection of the various coal mines. Mr. McKay was employed on the east coast of the Wellington district during September, in the Mount Potts district of Canterbury in October, and in the Wairoa and Dun Mountain district of Nelson in May. Lastly, the D'Urville island copper lodes were examined by Mr. Cox in August.

During the year twenty-six out of the thirty-two collieries now in work in the Colony were inspected and surveyed, and all the working plans brought up to date. The underground surveys were made in the first instance by Mr. Denniston, the government coal viewer, and afterwards, in most cases, inspected and passed by Mr. Cox, who holds the position of inspector under the "Regulation of Mines Act, 1874."

The following is a list of the collieries, with the date of the last inspection of each, and the yield of each year, for the year ending on 30th June:

District.	Date of Inspection.	Output for past year in tons.
Malvern Hills—		
1. Canterbury colliery	1st November, 1877	1,000
2. Wallsend "	3d February, 1878	1,462
3. Springfield "	26th October, 1877	1,435
4. Stevenson "	19th October, 1877	
5. Homebush "	13th October, 1877	2,235
Oamaru District—		
6. St. Andrew's colliery	10th November, 1877	50
7. Prince Alfred "	14th November, 1877	2,045
8. Awamoko "	16th November, 1877	400
Otago Coal Fields—		
9. Real Mackay colliery	11th and 22d January, 1878	306
10. Bruce "	11th and 19th January, 1878	1,583
11. No. 1 Kaitangata "	10th Dec., 1877, and 9th Jan., 1878	1,872
12. Kaitangata Coal Mining Co.	5th Dec., 1877, and 9th Jan., 1878	10,477
13. Shag Point colliery	27th November, 1877	2,622
14. Otago "	June, 1877	2,941
15. Freeman's "	June, 1877, and 7th January, 1878	5,006
16. Walton Park "	June, 1877, and 7th January, 1878	16,000
17. Samson's "	June, 1877, and 7th January, 1878	8,000
18. Saddle Hill "	June, 1877, and 8th January, 1878	4,000
19. Lawrence "	3d June, 1878	1,351
Greymouth District—		
20. Wallsend colliery	25th February, 1878	440
21. Coal-pit Heath colliery	20th February, 1878	6,138
22. Brunner "	22d February, 1878	21,974
Reefton District—		
23. Energetic colliery	15th March, 1878	500
Buller District—		
24. Wellington colliery	2d March, 1878	948
Collingwood District—		
25. Parapara colliery	31st March, 1878. Closed	
Auckland District—		
26. Miranda colliery	January, 1877	600
27. Taupiri "	February, 1877	
28. Kupakupa "	February, 1877	5,200
29. Waikato Coal Co.	(Not yet visited.)	600

Whangarei—		
30. Whauwhau colliery........10th March, 1877 (estimate)..........		2,000
31. Kamo " ....March, 1877........................		1,200
Bay of Islands—		
32. Kawakawa colliery.........April, 1877........................		36,599
Total output for Colony..................................		138,984

—*Jas. Hector.*

The Amyzon Tertiary Beds.—In Vol. 1 of the Report of the United States Geological Survey of the Fortieth parallel, page 393, the able author, Mr. King, has described an extensive series of beds, including many laminated shales, which are found in the northern part of Nevada, as constituting an extension of the Green river formation west of the Wasatch mountains.[1] He states that they contain the same species of fossil fishes as those of the Green river epoch. I published the first notice of this formation, which I examined at Osino and at Elko, Nevada,[2] and described from it two species of fishes, which were referred to genera previously unknown, viz: *Amyzon* and *Trichophanes.* These genera have not been found represented in the fish fauna preserved in the Green river shales, which embraces eight genera and twenty-four species. But they occur in several species and specimens in the South park of the Rocky mountains of Colorado, associated with the genera *Rhineastes* and *Amia*, neither of which has yet been found in the Green river formation. The first named is common in the Bridger, but in a different form, and the generic identity is not yet fully established. The *Amia* is represented in the Bridger by *Pappicthys*, but in the former the characteristic parts have not yet been seen in the South park specimens, so that here also the determination of the genus is not final. It, however remains, that this fish fauna is different from that of the Green river beds, and the modern aspect of the genera points to an age even later than the Bridger. It is evident that the pertinence of this series of rocks to the Green river formation, asserted by King, cannot be maintained. I have named this epoch that of the Amyzon beds, from the characteristic genus which it includes, and refer it to the later Eocene or early Miocene eras. Its fish fauna includes ten species, distributed as follows: *Trichophanes* Cope, 3 sp.; *Amyzon* Cope, 4 sp.; *Rhineastes* Cope, 1 sp.; *Amia* L., 2 sp.—*E. D. Cope.*

Gaudry on Permian Vertebrata. — Prof. Gaudry recently brought before the Academy of Science descriptions of several interesting types of *Batrachia* and *Reptilia* from the Permian of the Department of the Saone et Loire. Among these was *Actinodon* Gaudry, whose vertebræ are segmented so as to closely resemble those of *Rachitomus* (this journal, 1878). Another form allied to *Protriton*, was probably a terrestrial animal, and possessed

[1] L. c. 1, p. 393.
[2] Proceedings Amer. Philosophical Soc., 1872, p. 478.

a large tail; it was termed *Pleuronura pellati.* The third type was represented by a humerus which resembles that of the *Dimetrodon* of Texas, and similar forms from the Ural and South Africa, in presenting some Mammalian features. He referred it to a new genus, under the name of *Euchyrosaurus*, which is probably Pelycosaurian.

A STING RAY FROM THE GREEN RIVER SHALES OF WYOMING.—Leslie A. Lee, of Bowdoin College, Me., recently lent me for examination an interesting fossil from the above formation, from the locality which has recently furnished such fine specimens of *Mioplosus*, *Diplomystus*, etc. It is a species of sting ray nearly allied to the genus *Trygon*, but so far different as to be referable to another genus which I propose to name *Xiphotrygon.* Its characters are: teeth with produced triangular crowns as in *Raja.* Caudal spines compressed, with a single serrate-edge, which is dorsal. No caudal fins discoverable. The species has a rather long acuminate snout without superficial ossification, from whose apex the pectoral fin borders diverge. The latter do not extend posterior to the ventrals. Tail very long and slender, nearly twice as long as head and abdomen. Caudal spines (three present in the specimen) with a shallow lateral groove, but otherwise smooth. Pectoral rays 31 + 10 + 41. Total length m. .515; width at middle of abdomen .230; length of head .100; length of tail .351; length of spine .040. The species may be called *Xiphotrygon acutidens.* The *Trygon muricata*, of Monte Bolca, has the typical form of spine, according to Gazzola.—*E. D. Cope.*

AMERICAN ACERATHERIA.—Four species of rhinoceroses have been found within the limits of the United States, which may be referred to the above genus. They are, commencing with the smallest, *A. mite* Cope, *A. occidentale* Leidy, *A. pacificum* Leidy (=*A. ? hesperius* Leidy, from Oregon) and *A. truquianum* Cope, n. sp., from the John Day river deposit of Oregon. The last named is the largest American species, nearly equaling the *Aphelops megalodus* of the Loup River formation. It is only known from an incomplete mandible, which supports molar, canine and incisor teeth. The former have the usual form. The crowns of the canines are considerably wider than those of the incisors, but do not project very far beyond them. They are subtriangular in outline, having a prominent shoulder at the base on the inner side. There is but one incisor on each side, which has a transverse crown. Diastema long; ascending ramus vertical, flat in front. Depth of ramus at last molar. 065; length of last molar .045; width of do. .029; length of crown of canine .027; width do. at base .024.

From beds of the Truckee epoch of the White River formation. This name, introduced by King, has priority of publication over the term Oregon beds introduced by me, hence the latter must be abandoned.

I add that the genus *Aphelops* differs from *Aceratherium* in the presence of but three toes on the anterior foot, and from *Rhinoceros* in the absence of horn.—*E. D. Cope.*

THE LOWER JAW OF LOXOLOPHODON.—Messrs. Speir and Osborn contributed to the April number of the *American Journal of Science and Art*, a very interesting account of the mandible of *Loxolophodon cornutus*, which has been hitherto unknown. It presents characters as curious as those of the cranium. The incisors and canines are similar, and have remarkable bilobate crowns, and there is a slight expansion of the lower margin of the ramus to represent the wide phlange of *Uintatherium.* The authors of the paper have not consulted the literature as carefully as they might have done, and have thus been led into error in several points. They think that the mandible of *Loxolophodon* had been already described by me, and that erroneously; whereas the description to which they refer, is that of another species, probably of another genus, found in a different Bridger basin. It was not identified, and was described only as "resembling that of *Uintatherium*." They confirm my description of the furcate character of the premaxillary bones, while seeming to disapprove of it. They also appear to suppose that the question of the possession of a proboscis is identical with the question of Proboscidian affinity, which are really dissimilar propositions.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

AFRICAN EXPLORATION.—Dr. Rohlfs left Tripolis about Christmas. Letters dated January 27, 1879, at Sokna, some 250 miles south of Tripolis, have been received, from him, at Berlin. They include a valuable zoölogical report by Dr. Stöcker and a number of astronomical observations. Sultan Ali of Wadai, who treated Dr. Nachtigal so hospitably, is dead, but his brother, Jousouf, who succeeded him, is said to be equally well disposed towards foreigners.

Capt. Roudaire reports favorably on the experimental borings made by him along the neck of land separating the gulf of Gabes from the Saharan depression. Nothing but sand and soft soil were encountered down to a depth of one hundred feet. There are no rocks, and M. de Lesseps expresses himself satisfied that the construction of a canal will meet with no difficulties. The scheme, however, of converting this portion of the Southern Sahara into an inland sea is severely criticized; it is said that, if successful, it would destroy the date-culture, and owing to the prevalence of northerly winds would not exercise any favorable influence upon the climate of Algeria.

Mr. Mackenzie, the African traveler, sailed from England recently for Cape Juby, on the north-west coast of Africa, in a

[1] Edited by ELLIS H. YARNALL, Philadelphia.

specially chartered steamer, for the purpose of opening that region to commerce.

M. Paul Soleillet, according to the last intelligence received in Paris, had reached Sego and was proceeding onwards.

One of the most important explorations recently accomplished is that of the river Ogowé, the largest river in the French colony of the Gaboon. This expedition, commanded by M. Savorgnan de Brazza assisted by Dr. Ballay, has now returned after three years of hardship and danger, having had to struggle against the ill-will and cupidity, and eventually the open hostility, of the natives. The Ogowé may be divided into three almost equal parts, the upper, middle and lower. The middle portion follows the equator as nearly as possible, and the other two incline about a degree and a half southwards, the one towards the source and the other towards the mouth. MM. de Brazza and Ballay started from Lambaréné, the extreme limit of the European factories, in August, 1875. They halted first at Lopé, a large village on the middle course of the river, whence M. de Brazza went by land into the country of the Fans, who were friendly, and from thence to Doumé, much higher up the river, where he was rejoined by Dr. Ballay. Above the Poubara falls the Ogowé becomes an insignificant stream. Having ascertained that it did not communicate with the great lakes in the interior, they left the basin of the stream, which evidently has its source from a high plateau not very distant from the coast. They now suffered much from want of food and water, but continuing on reached the N'yambo, a stream flowing eastward, and which brought them to the Alima, a large river not indicated upon any map. It was here 165 yards broad and sixteen feet deep, and is thought to be one of the affluents of the Congo. They followed it for some distance partly on foot, partly in canoes, but owing to the attacks of the savages were finally obliged to abandon the stream, which continued to run eastward. The country was here a vast swamp, the houses of the natives being built on piles. Turning towards the north the tribes proved less inhospitable, but provisions were procured with difficulty, and they were frequently from twenty-four to thirty hours without food. After crossing several streams, all of which flowed eastward, the expedition was obliged to separate; M. de Brazza pursuing his journey beyond the equatorial line, while Dr. Ballay awaited him at the falls of Poubara. The rainy season drawing near, the former rejoined his companions, and descending the Ogowé the expedition arrived at Gaboon on November 30, 1878. During the last five months they had to march barefooted. About 800 miles of ground were covered, nearly all of which was previously unknown. M. de Brazza contemplates renewing his attempt during this year and exploring some of the other affluents of the Ogowé, which may prove of greater importance than the branch now made known. A cor-

respondent of the *Athenæum* (February 22, 1879) says: "The experience of M. de Brazza confirms Mr. Stanley's description of the warlike character of the tribes on and near the Congo, and we may fairly infer that no exploration of these regions can be successfully carried out except by a strong party, and by the occasional resort to force, in order to overcome the opposition of the hostile tribes." MM. de Brazza and Ballay are now in Paris, where they have received many honors, including the bestowal of the great gold medal of the Paris Geographical Society.

Herr von Koppenfels has recently been exploring the country inland from Gerisco bay, in West Africa, a little to the north of the Gaboon. He ascended the river Muni as far as the rapids of the Tampuni, and traveled thence by land, apparently following Du Chaillu's track. In the Crystal mountains he fell in with tribes absolutely unknown to Europeans. They are weak, poor and very inoffensive. Their country abounds in elephants and gorillas whose depredations are much dreaded, as the people appear to have no means of protecting plantations or gardens from their incursions. The tribes dwelling further inland are described as peaceable.

Herr Schütt, who has been sent by the German African Society to explore the interior of West Africa, from Loanda, has been attacked and robbed by the Bengala tribe on the Quango river, and been obliged to turn back to M'Banza Muango, on the river Lui (9° S. lat.). He has prepared a tolerably correct map of the entire plateau between 8° and 10° S. lat. with all the numerous streams that flow from it. He was determined to continue his work, and was, when last heard from (August, 1878) preparing to cross the Quango and open up the direct way to the north.

Major Serpa Pinto has arrived at Pretoria, in the Transvaal, with eight followers, the remnant of four hundred. In the January number of the NATURALIST we mentioned his intended departure from Bihé for the Upper Zambesi on the 18th of May, 1878. He telegraphs to the Portuguese government, "In concluding my journey across Africa, I struggled with hunger, thirst, the natives, floods and drought. I have saved all my papers—twenty geographical charts, many topographical maps, meteorological studies, drawings and a diary of the complete exploration of the Upper Zambesi, with its seventy-two cataracts." He says, according to the *Nature*, "he has discovered the secret of the Cubango, by which he seems to mean the river which under various names was for a time taken by some to be the upper course of the Congo." Major Pinto's companions, Capello and Ivens, who separated from their leader at Bihé, have not as yet been heard from.

The (English) Baptist Missionary Society have, according to the Academy, decided to despatch an expedition under Mr. T. I. Comber, with instructions to make San Salvador, to the south of Yellala falls, the base of operations, and if possible to occupy

Makouta, to the north-east of that place; they are further to leave no effort untried to reach the Upper Congo river near Stanley Pool(about 4° S. lat. 17° E. long). It is contemplated to send a small steamer in sections for the navigation of the Upper Congo. San Salvador district is much more healthy than the coast, and the country is very productive. The people are described as very quiet.

MICROSCOPY.[1]

ON A STANDARD FOR MICROMETRY.[2]—When the subject of a standard for micrometry came before this society at the suggestion of the late National Microscopical Congress, we found ourselves unable to vote satisfactorily upon it; not for want of any definite desire in respect to it, but because it seemed evident that a mere affirmative or negative answer to the proposals of the congress would not accomplish any desired result. For a few individuals or societies to commit themselves positively either for or against the proposals might even render valuable progress on this important subject more difficult. The differences of opinion were so strong and so reasonable, and the other interests involved were so diverse and wide spread, as to call for a thorough conference before adopting any definite policy. We therefore proposed a national committee to investigate the subject, confer with persons wishing to be heard or likely to give valuable information in respect to it, and place the data thus obtained at the service of all parties interested. As yet we have heard of no opposition to the appointment of the proposed committee. The whole spirit of the world's science at the present day calls for the highest possible precision in determining questions of the form and size of objects. It is well known that such precision has not yet been attained in micrometry; and it is difficult to believe that any one who desires to give a respectful hearing to the wishes of his fellow students, could seriously object to submitting this manifestly important subject to the consideration of a suitable committee. Whether in favor of one action, or of another, or of none, we should certainly be willing that all opinions and preferences be heard before making our final decision.

As to the course which should be adopted by the committee, or recommended to the country, there is, however, the greatest room for reasonable differences of opinion. And the same reasons which make a committee necessary, should require us to submit our views with candor and plainness, but without demanding or expecting that they shall be adopted as a whole. A fair hearing and a respectful consideration is all that can be asked by any one in such a case. And for the same reasons, any action

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

[2] Remarks at the Microscopical Section of the Troy Scientific Association, December 2, 1878, by R. H. Ward, M.D.

taken by a committee or by any society or group of societies, should be suggestive or advisory and not positive or dictatorial.

There may even be some who believe that nothing useful can be accomplished in this field; but a second thought may show that much good can be effected, without doing anything of doubtful expediency. It seems unfortunate that in the suggestions of the congress more prominence was given to those points in regard to which there is greatest difference of opinion, and most intelligent doubt as to what ought to be done, than to the more important want underlying them. What we need is precision, first, and afterwards uniformity of nomenclature if we can get it. The essential part, on which all should agree, is that statements of size and distance should have a definite meaning; that when an author mentions, for instance, the 1–1000 of an inch, or the 1–100 of a centimetre or of a millimetre, that statement should mean one and the same thing to him, the writer, and to all intelligent readers. This certainly is not true in regard to the measurements made and recorded with the microscope in the past or at the present time. The best stage micrometers in use, as a basis for measurements, are well known to differ among themselves by various and easily measurable discrepancies which must represent errors on one side or both. In comparing micrometers from different sources, differences of two per cent. have been often noticed, and sometimes as high as six per cent. Far less errors than these, and as are quite generally present, must greatly impair the scientific value of all measurements; and it may be safely said that the exact degree of accuracy of the instruments used, and therefore of the measurements recorded, by observers with the microscope, is seldom known to the authors themselves, and scarcely ever to the readers of their papers. Nor can individual care and labor overcome this difficulty. A student can reject conspicuously bad rulings, and take the average of the best within reach; but cannot know, at last, exactly how well his best scale represents its nominal value. To determine how nearly the 1–100th of an inch on our glass plate corresponds to the 1–3600th of the standard yard in London or of our national copy of that standard in Washington, is a most valuable result which can be attained only by concerted action, and is well worthy the labor of any committee or of any society. We need a tangible inch, whether called a "standard" or not, which should be, as nearly as can be detected by the modern microscope, or by any other known means, the 1–36th part of the standard yard; or a centimetre corresponding equally well with the 1–100th of the standard metre; or some other equally determined unit, which should be officially recognized as authority for all who desire the greatest attainable accuracy. If so accurate a subdivision exists among the national standards at Washington, it might be verified by the committee, and arrangements sought from those having it

in charge by which it could be made practically useful to the microscopists of the country. If such a standard does not exist, one should be made; or if it is not within the power of our present art to give results in which the microscope cannot find a fault, then the end could be attained, measurably well, by selecting a standard as perfect as possible, and attaching to it a statement of its carefully determined error.

This standard, if it be proper to call it a standard at all, should be selected by, or made for, the committee, should be the property of the nation, and should have no mercantile relations whatever. By means of a limited number of very carefully verified copies, which could also be used as a means of reconstruction in case of accidental destruction of the original, it could be rendered available to all persons who make or use micrometers. The cheapest commercial scales, even, could without increase of price be accompanied by a statement as to how closely the work of the screw which ruled them has been found to correspond with the standard; and all plates claiming a high degree of accuracy could be carefully compared, space for space, and accompanied by a statement of the ascertained error of each individual space. Persons of really scientific training would gladly incur the extra expense of such a corrected scale. Even a series of microscopical measurements already completed and published might, in some cases, receive additional value by a note, added in later editions, stating how nearly the apparatus used by the author has been found to correspond with the standard afterwards adopted.

Of course this standard would deserve the name only in a limited sense, and not in the same sense as the standard yard in London and the standard metre in Paris; but it would be an officially recognized representative of some unit practicable in microscopy, and it might be made to add greatly to the uniformity and value of our work.

The material of which the standard should be made, the form it should take, the manner in which the spaces should be indicated, the temperature at which it should be standard, and the manner in which it should be made available to the public, and in which its safety could be best secured, could only be determined after careful consideration of the world's recent experience in respect to the care and use of precise measures of length. It has even been debated whether the practical standard should be a ruled plate or a spacing screw for use in ruling plates. But as the work of a screw is known to vary considerably according to the conditions of its use, some of which conditions are not easily controlled, the adoption of a screw, however accurate it might be, would be likely to result in the dissemination of a number of ruled plates possessing equal authority as standards, but differing measurably from each other. Whether the micrometric standard should be taken from our national standard, at Washington,

which is itself a copy, or from the world's standard in Europe, and whether coöperation with other countries is feasible in this work, are important questions for consideration.

Whether the standard secured should be a fraction of the yard or of the metre, and how large a fraction, I, for one, should scarcely have an opinion until the committee should ascertain how generally each system is used by the workers of the country, and how freely those workers would be willing to adopt the new system by general agreement. Whichever system is adopted, many microscopists would be glad to have a convenient unit in the other system, verified by comparison; a standard centimetre divided into one hundred parts, for instance, being accompanied by an inch similarly divided and having, microscopically, the same relation to it that it has mathematically. This method, of possessing a practical standard in each system while technically improper, would be a convenience, and would give a great improvement in our micrometry. Nor would the objection that it might hinder the universal adoption of the scientific (metric) system be a serious difficulty to my mind. The adoption and rejection of systems is a matter of evolution, not artifice, and the world will move at a rate that depends upon its average interests, without being much affected by special efforts to advance or retard its progress.

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SCIENTIFIC NEWS.

— The President nominated Clarence King for the directorship of the U. S. Geological Survey recently created by act of Congress, and the newspapers state that the Senate has confirmed the appointment. Of Mr. King's merits as a geologist we need not speak, as the Report of the Survey of the Fortieth parallel is an enduring monument to his ability. We shall hope that the fullest measure of success may attend the new Bureau and its distinguished director.

— It is with great regret that we learn that Frank A. Bradley, the well-known geologist, was recently crushed to death by the caving of the wall of a gold mine in Georgia. Mr. Bradley had at different times filled positions on the geological surveys of various States, including New York, Illinois, Tennessee and Georgia. He wrote many reports, and is the author of a geological map of the United States.

— Prof. George B. Wood, president of the American Philosophical Society, and formerly professor of the Institutes of Medicine in the University of Pennsylvania, recently deceased at the age of eighty-two years. He is well known as the author of Wood and Bache's Dispensatory, the standard work on the subject in this country. He left important legacies to the University

of Pennsylvania, including an endowment for several chairs in connection with the medical department; to the American Philosophical Society, etc.

— Prof. Samuel T. Sadtler has recently been elected to the chair of chemistry in the Department of Arts of the University of Pennsylvania. Prof. Sadtler is a native of Pennsylvania, and is well known as an expert in the analyses of mineral oils, etc.

— The Buenos Ayrean collection of vertebrate fossils, exhibited at the Paris Exposition arrived at Philadelphia by the *Indiana*. It is to be exhibited in the biological department of the Permanent Exposition.

— B. Waterhouse Hawkins has been lecturing on vertebrate palæontology, in London, this winter.

— It appears by a paper communicated to the Geographical Society of Paris, by M. Jules Garnier, that in the island of New Caledonia the usual vegetable productions of the tropics grow well on the island, but excepting coffee and tobacco they were subject to periodical destruction by invasions of grasshoppers.

— We have received the Constitution and Record of Organization of the State Natural History Society of Illinois, with a list of original members, which number fifty-two. This is one of the most active scientific organizations of the West.

— In the Proceedings of the Zoölogical Society of London, lately received Mr. T. J. Parker publishes a note confirmatory of Prof. Moebius' account of the stridulating organs of the spiny lobster (*Palinurus vulgaris*). The noise or stridulation is almost equally audible in water and air. Moebius compared it to the sound produced by pressing the upper leather of a boot against a table leg.

— A valuable paper by Prof. Vogt on the adaptation of Copepodous Crustacea to parasitism, appears in the last received number of Actes de la Société Helvetique des Sciences Naturelles. Bex, 1878. The author believes that evolution should be studied from an examination of parasitic and blind animals, as showing the influence of a change in the environment on the structure of the animal.

— At a recent meeting of the London Entomological Society the Rev. A. Eaton exhibited a piece of "Kungu cake" from Lake Nyassa district, where, according to Livingstone and others, it is used extensively as food by the natives, who manufacture it from large quantities of a minute insect, conjectured to be a species of *Ephemeridæ*. From an exhaustive examination, however, Mr. Eaton found it to be a minute representative of the Culicidæ, or mosquito family, probably belonging to the genus Corethra. In connection with the subject of insect-food as used by

man, Mr. Distant remarked that he had learned from Mr. Chennell that *Erthesina fullo*, a very common eastern hemipterous insect was largely eaten by the Naga Hill tribes of North-eastern India. Mr. Meldola remarked that chitine, which comprised the crust of insects had been shown by analysis to contain about six per cent of nitrogen, and as regards phosphates, Mr. Wm. Cole had burned some insects and found phosphoric acid in the ash.

— A laborious work, redounding to the credit of both parties, is Mr. Samuel Henshaw's list of the entomological writings of John L. LeConte. It forms a pamphlet of eleven pages, edited by George Dimmock, and is No. 1 of Dimmock's Special Bibliographies. Dr. LeConte has thus far published 250 papers and works. We hope to record the publication of many more from his pen. The second number comprises the entomological writings of George H. Horn, compiled by Samuel Henshaw, edited by George Dimmock. The titles number 80. The third part is in preparation, giving a list of the writings of Samuel Hubbard Scudder; compiled and edited by George Dimmock. Mr. Scudder's writings number over 250 titles. These have, or will appear in the Advertiser of *Psyche*, the organ of the Psyche Entomological Club, Cambridge. These bibliographies are done with unexampled faithfulness and care, and can be purchased of the editors of *Psyche*, Cambridge, Mass. This journal desires and needs more subscribers. The subscription is $1.00 a year. It is doing a good work for the progress of entomology in this country, and contains matter of much general interest; the bibliographical portion being a valuable feature. We would only make one criticism, *i. e.*, in the use of lower case initial letters of names of genera and higher groups; this is an innovation which we should not desire to see followed.

— The fourth volume of the Transactions of the Wisconsin Academy of Sciences, Arts and Letters, just received, among a number of comparatively worthless papers, contains besides Prof. Birge's notes on Cladocera, already noticed in this journal, a paper by Dr. E. Andrews on discoveries illustrating the literature and religion of the Mound-builders. Dr. P. R. Hoy contributes two papers entitled, How did the Aborigines of this country fabricate copper implements? and Why are there no upper incisors in the Ruminantia? Dr. J. N. de Hart writes on the antiquities and platycnemism of the Mound-builders of Wisconsin, while Prof. T. C. Chamberlain publishes an essay on the extent and significance of the Wisconsin kettle moraine.

— At its last session Congress appropriated $10,000 for the completion of the investigation of the Rocky Mountain locust by the United States Entomological Commission. The work during the coming season will be carried on in Colorado and the Western Territories, particularly Utah and Eastern Idaho, where the locust abounds each summer, doing more or less damage.

Parties will also be sent into Montana, the main breeding place of the destructive swarms periodically visiting the Western Mississippi States.

—The cryptoganious division of the Herbarium of the Boston Society of Natural History has been enriched by the discovery of a valuable collection of lichens. This was formerly the lichen-herbarium of Dr. Thomas Taylor, an Irish botanist, to whom Sir W. J. and Sir Joseph Hooker communicated the whole of their extensive collections of lichens, gathered during many exploring expeditions. Dr. Taylor published descriptions of these plants in the London *Journal of Botany*, 1844–46, and many of the specimens are the originals of the descriptions. In 1850, Mr. John A. Lowell purchased the collection from Dr. Taylor's heirs, and it formed a part of the herbarium subsequently presented by him to the Society. The knowledge of the structure of lichens has been greatly advanced since Dr. Taylor's day, by the use of the microscope, and the nomenclature has undergone extensive changes. This herbarium, though consisting of over a thousand species, might have remained comparatively useless to the American student, had it not been for the voluntary services of Prof. Edward T. Tuckerman. He has examined and named very nearly the entire collection, a work which no one else in this country could have done, and has given it an authentic value otherwise unattainable.

—The French Academy of Science has elected M. Marey, Professor of Animal Mechanics in the College de France, to M. Claude Bernard's vacant chair.

—In a recent report to Parliament, it seems that last year 21,682 fatal cases from the attacks of wild animals had occurred in ten provinces of India, the largest number being in Bengal, namely, 10,062. The deaths from snake bites alone in the Punjaub last year, were 828 against 979 in the preceding year.

—As our readers are aware, the three great geological surveys under Hayden, Powell and Lt. Wheeler are, by Act of Congress, to be discontinued after the 30th of June, and to be replaced by a new U. S. Geological Survey in charge of Mr. Clarence King, late geologist of the Survey of the Fortieth Parallel. It was as far as we are aware the original understanding when the matter was referred by Congress to the National Academy of Sciences to simply consolidate the existing geological surveys, but the report of the Committee was so worded that these surveys were abolished outright instead of being consolidated. The amount appropriated for the new geological survey is $100,000, a little more than each of the other surveys have formerly received. Thus the work is apparently to be greatly curtailed, and science and the best interests of the western people will, in a corresponding degree, suffer.

It is greatly to be regretted that the work is in the future apparently to be conducted on so narrow and limited a scale, for which the scientific world may thank the two or three naturalists who have been conspicuous in shaping legislation in this whole matter. It has even been strongly intimated that hereafter no zoölogy and botany is to be connected with the future geological work. This is to be deprecated by biologists throughout the country, who are probably unaware how much has been done to influence those in authority at Washington, and to prejudice them against giving national aid to these sciences. All this is a new feature in the history of science in this country, and has been, we are led to believe, the result of narrow, local private jealousies, rather than from any generous, catholic, scientific spirit. Since the time of Lewis and Clark's Expedition, naturalists have been sent out with the national scientific expeditions, at little expense to the general government; with nearly all surveying parties, topographical and geological; the reports of the naturalists of the U. S. Exploring Expedition, of the Pacific Railway Surveys, of the naturalists who have prepared the botanical and zoölogical reports of Hayden's Survey, have added immensely to the prestige of American biological science; it has been done at little extra expense, most of the cost of printing not having been paid for out of the funds appropriated for the surveys themselves. No richer results in biology and palæontology and physical geology combined have been elicited in this country than the researches carried on by Pourtales, the two Agassizs and those associated with these scientists, in the dredgings made in deep water from Florida to Maine on the vessels of the U. S. Coast Survey; and yet it has been urged on legislators and those in authority at Washington, with singular inconsistency, by certain of those who have and are even now enjoying the results of the biological work thus inexpensively carried on with the U. S. Coast Survey, that no zoölogy or botany should be connected with the geological surveys!

From the very fact that the largest, best known survey in this country and in Europe, one which more than any other survey in this country, unless we except the New York State Survey, has won the warmest sympathy and interest from the leading geologists and palæontologists of Europe—from the very fact, we say, that the survey in charge of Professor Hayden has been conducted in a liberal, catholic way, and so as to promote and diffuse among the people who are paying for the work done, a knowledge of the natural resources of the Far West, we had hoped that after more than twenty years of service in the field, he would have been allowed to extend and complete the work in the manner already begun. We would see no curtailment of the work, and in voting in the meeting of the National Academy for consolidation, we supposed that with the moral support of the Academy, Congress would vote still larger supplies, and have the work done in a liberal, broad, comprehensive spirit consistent with

the magnitude of the interests involved, and especially that no grave injustice would be done in selecting those who should have charge of the work. There was room for the employment of all who were engaged in the work now going on, and we firmly believe that had Prof. Henry, the lamented promoter of American science in its broadest spirit, presided over the councils of the National Academy, the result would have been far different.

Mr. King has our congratulations and best wishes, and we trust he will liberally construe the recent Act of Congress, and conduct the surveys to be under his charge in the liberal spirit already shown in the series of elaborate reports of the Fortieth Parallel, one of the most expensive of which treats of the botany of the Survey.—*A. S. Packard, Jr.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Jan. 22.—President Ruschenberger in the Chair. Mr. Meehan called attention to some specimens of *Solidago odora*, which was used in some parts of Pennsylvania as tea. Mr. Ashburner exhibited some charts intended to illustrate the geological faults in Jack's mountain, Pa. Mr. Potts exhibited some silkworm cocoons in which the skin cast off from the trachea within was shown, and also that two worms spun a single cocoon in co-partnership. Mr. John Ford exhibited an oyster, the shell of which was almost destroyed by the common boring sponge.

Jan. 28.—The President in the Chair. A paper entitled, Further Notes on the Mechanical Genesis of Tooth-forms, by John A. Ryder. Dr. Leidy exhibited a mass of worms from Cecil county, Md., supposed to be *Gordius robustus*, also the liver of a rat much infested with *Cysticercus*.

Feb. 4.—The President in the Chair. Dr. Leidy described the fossil jaws and teeth of a deer from Muscatine, Iowa, for which he proposed the name *Cervus muscatinensis*. Dr. H. C. Chapman made a communication on the chimpanzee which recently died at the Zoölogical Garden, arriving at the conclusion, and agreeing with Prof. Owen, that the cerebrum did not fully cover the cerebellum, as held by Huxley and others. Detailed comparisons were also made in regard to the arrangement of the muscles.

MIDDLESEX SCIENTIFIC FIELD CLUB, Malden, Mass., organized March, 1878.—The Club held its first annual meeting March 5, 1879, and elected the following officers: President, Henry L. Moody; vice-presidents, Rev. Geo. P. Huntington, Frank S. Collins, Mrs. P. D. Richards; corresponding secretary, Geo. E. Davenport; recording secretary and treasurer, F. W. Morandi; custodian, Miss Hattie Silvester; Exec. Com., L. L. Dame, Geo. E. Davenport, Mrs. Annie U. Moody, Miss Martha Silvester, F. W. Morandi.

The Club propose to investigate, and, if possible, establish a museum illustrating the natural history of Middlesex county.

For this purpose special departments in the different branches of natural science have been organized, under the direction of the Executive committee, and the botanical department has been divided into sections for the better prosecution of that portion of the Club's work.

Mr. Dame, assisted by Mr. Huntington and Mr. Roscoe Frohoch, will have charge of the Phænogamous sections, Mr. Davenport of the vascular Cryptogams, and Mr. Collins of the Algæ.

The entomological department will be in charge of Mr. Moody, and the ornithological department conducted by Mr. Wm. B. Gibbs. Communication with the Club may be had by addressing the corresponding secretary, at Medford, Mass.

New York Academy of Sciences, March 17.—Mr. A. A. Julien gave an account of simple devices in determinative lithology, and Prof. T. Egleston read a paper on pre-historic mining at Lake Superior.

American Geographical Society, New York, April 8.—Mr. William I. Marshall read a paper on the Yellowstone National Park, with a description of the wonders of that region.

Appalachian Mountain Club, Boston, April 9.—The Councillors presented their spring reports, and a paper was read by Prof. F. W. Clarke, entitled a trip to North Carolina, describing the mountains of that State.

April 16.—Mr. Justin Winsor delivered an illustrated lecture on the earliest maps of the American continent.

Boston Society of Natural History, April 2.—Rev. G. F. Wright made a communication on the medial and terminal moraines of New England. Mr. Warren Upham read a paper on the glacial drift in Boston and vicinity, and Dr. C. S. Minot remarked on histological differentiation.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

Siebold and Kölliker's Zeitschrift für wissenschaftliche Zoologie.—March 13. The Anatomy of Amblystoma weismanni, by R. Wiedersheim. On pelagic Annelidans from the shores of the Canary islands, by R. Greef. The motions of our land snails, by H. Simroth.

American Journal of Science and Arts.—The Vertebræ of recent birds, by O. C. Marsh. The lower jaw of Loxolophodon, by H. F. Osborn and F. Speir, Jr. Notice of recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill.

The Canadian Naturalist.—March 22. Remarks on recent papers on the geology of Nova Scotia, by J. W. Dawson. Notes on the glaciation of British Columbia, by G. M. Dawson.

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PROF. HARTT ON THE BRAZILIAN SANDSTONE REEFS.

BY RICHARD RATHBUN.

THE sea-coast of Brazil, from the mouth of the Amazonas to near Victoria, is generally low and of quite uniform character, being everywhere faced with broad, open beaches of sand that extend for miles and miles without interruption. A less inviting region than this to the explorer can scarcely be imagined, and it stands in marked contrast with the more tempting inland districts, especially those in the Amazonian valley, which have always caused Brazil to be considered a sort of naturalists' paradise. It was little suspected, until a few years ago, that this unattractive coast harbored very extensive and curious coral reefs, and displayed, in connection with its beaches, interesting phenomena whose true character had been entirely misunderstood.

Some of the earlier writers on Brazil endeavored to describe this region, relying either on their own imperfect observations, or on what others had seen, and adding, apparently, here and there, numerous details, the products of their own fertile brains, perhaps, to smooth over and complete the sketch.

These very inaccurate accounts gave credence to the existence of a long bar or reef of stone, bordering the entire coast from north of Cape St. Roque to the southward of Bahia. Piso, in his work published in 1648, described this reef, and he has been copied over and over again by nearly every author who has written on this subject since his time, no one ever having taken the trouble to test the accuracy of his statements. Even Staff-Commander Penn, in the "South American Coast Pilot,"

treats of "the *recife*, a singular ridge of coral rock," bordering the coast, at a distance from it of about half a mile to three miles or more, and extending from the north-east part of Brazil to south of Bahia. According to his accounts, the reef is about sixteen feet broad at the top, forming a natural breakwater, with smooth and shallow water inside, affording a channel for coasters. "It is broken occasionally, and forms, by the openings, entrances to the greater part of the ports, rivers and creeks on the coast."

Gardner describes the mythical reef in nearly the same terms, and there can be no doubting the fact that these two writers have reproduced Piso's old description, with many additional details thrown in gratuitously.

It is needless to state that these accounts of a continuous reef were without foundation, but they served, more or less, to mould the world's ideas of the character of that coast up to the time when the late Prof. Ch. Fred. Hartt published the results of his careful and painstaking explorations of that region. Whether this observer was the first to rightly interpret the structure of the Central Brazilian coast or not, he, at least, has given the only extended and intelligible account of it. He has shown that although stone reefs occur at many localities, they are far from being universal, or even continuous over any great distance.

Quite distinct from these are a series of coral reefs, often lying near the shore, but much more developed farther out, rising upward from the surface of the submerged border of the continent.

As a member of the Thayer Expedition in 1865, Prof. Hartt examined two quite perfect stone reefs, at Porto Seguro and Santa Cruz, in the province of Bahia, and at several places in the province of Espirito Santo he also found traces of the same structure, lying near the beach, however, and not forming true reefs. On his second trip, in 1867, he was able to study the larger and more perfect stone reef of Pernambuco, and to detect a similar formation on the beaches about Bahia. A full statement of these investigations, and of his theory of the origin of the reefs, is given in his "Geology and Physical Geography of Brazil," published in 1870. Darwin, who touched at Pernambuco on his memorable voyage, arrived at nearly the same conclusions regarding the mode of formation of the reef at that place, as did Prof. Hartt, but his description of it is very brief.

Immediately upon the organization of the Geological Commission of Brazil, in 1875, under the leadership of Prof. Hartt, active field operations were commenced in the province of Pernambuco, and another opportunity was thus afforded the late chief to examine that most noted of all these natural breakwaters. With the larger force and more perfect appliances now at his command, he proceeded to carefully map out the reef and its surroundings, and to study in detail every feature connected with it. This extended investigation did not materially alter his previously-formed ideas as to the true character and mode of growth of the reef, but there were added many facts not before observed.

Other stone reefs, at Cape Sto-Agostinho, Parahyba do Norte, etc., were explored by the Commission, and the conclusions arrived at, after comparing the results of all these studies, are of great interest and importance, demonstrating that on the coast of Brazil conditions obtain for the united working of a set of simple forces which, apparently, are not perfectly combined, at least with the same results, in any other part of the world. As we can best understand these phenomena after becoming acquainted with the structure and appearance of a single reef, we will first describe the one at Pernambuco, partly in the very words of Prof. Hartt, and then discuss the subject as a whole.

Just to the south of the city of Pernambuco, a little river breaks through the land, and would open directly into the sea were it not that a narrow wall of stone, running in a general way parallel to the shore, carries its course some distance farther north, to beyond the limits of the city. Another small river, near its mouth flowing parallel with the sea, and separated from it by only a narrow strip of land, runs through the city of Pernambuco, and opens also behind the reef.

There is thus formed a small and very shallow bay, which is continued northward past the city, as a rather narrow channel, having a width of only a hundred rods or less, and a depth of but a few fathoms. The outlet to this channel is close to the northern end of the reef, and is so shallow as to admit only coasting steamers and vessels of ordinary draught. It is, however, the protecting reef and not the narrow harbor that interests us now.

Standing upon some prominent point near the shore, in Pernambuco, we can plainly trace this narrow strip of stone from its commencement, about opposite the ancient fortaleza do Brum,

situated to the north of the city, to the Ilha dos Pinhos, at the south. Its course is south, a few degrees west, and it runs in a nearly straight and unbroken line to near the latter place, where, however, it is cut through so as to afford a passage-way for small boats and jangadas. From this point to its southern end it is much broken up and generally irregular.

But to examine it the more closely we must land upon it at low tide, and walk along its nearly level surface, stopping at times to investigate any unusual appearance that may attract our attention.

The reef rock is a sandstone, of a light brownish tint when wet by the waves, and is formed of siliceous sand and rounded pebbles, mingled with which are many perfect and broken shells, all firmly cemented together by carbonate of lime. The most abundant shell in the sandstone is a species of Venus, still very common on the neighboring shores, and preserving in the rock its natural colors.

At its northern end the reef is very narrow and has, apparently, been much undermined and worn by the waves, for it is lower here than to the south, and the sandstone lies in immense blocks, inclined toward the sea. To increase its height and better protect the harbor at this place, an artificial wall, partly of brick and mortar, partly of reef stone clamped together, has been constructed. That the reef formerly extended much farther northward is evident from the existence of an isolated mass of reef rock just off the northern end, and of a stretch of submerged reef beyond the channel. Upon the extreme point of the reef stands the Pernambuco light-house, and a short distance from it is a little old octagonal fort, called Picao, built of reef stone, and occupying the entire width of the reef.

Following southward, the reef becomes broader and more level on top, but is still very irregular at the sides. In front of the city it has an average width of about two hundred and fifty feet, and a height equal to about that of high tide, though on account of the great commotion made by the waves at such times, it is impossible to exactly determine this fact. As to the thickness of the reef, it must reach down to below the level of low tide, because the rock is never entirely uncovered by the water.

The highest part of the reef forms a broad belt of varying width, whose axis lies a little to the inside of that of the reef.

From this belt the surface slopes more or less strongly on both sides, but presents quite different characters, resulting from differences in exposure. The outer side of the reef has become very irregular from the constant beating of the surf, and is pierced with innumerable cavities of sea-urchins and thickly overgrown with sea-weeds and calcareous incrustations. The inner side, after a more or less rapid landward slope, breaks down abruptly and irregularly, and often presents an overhanging edge.

The reef is cut up into large blocks by joints or cracks, which, though quite variable in their courses, may be reduced to two general series, one parallel to the axis of the reef, the other transverse to it; but many run obliquely or radiate from a common center, as though the reef at that point had settled down upon a hard underlying spot; sometimes they form a tangled maze. These joints are vertical or highly inclined, and the angular masses resulting from them are likely to be detached, on the outer side of the reef by the force of the waves, and on the inner side by the undermining action of the currents in the harbor. In this manner the margins of the reef have been made very jagged, the outer being the most irregular. On the upper surface of the reef, where there has been no dislocation, the joints tend to widen by the action of the surf and by chemical decomposition. There are thus formed open passages, a foot to a yard or more in width, and with a considerable depth of water. In these we always find a rich collection of marine animals, corals and other polyps predominating.

Now let us inspect more minutely the character of the surface, and the many foreign objects living or growing upon it, which tend either to protect it from wear, or to gradually and surely effect its destruction. As stated above, sea-urchins are burrowing into its outer edge. There is only a single species on the Brazilian coast that is able to excavate in the solid rock; it is the *Echinometra subangularis*, everywhere abundant, and possessed of stout, sharply-pointed spines. On abrupt slopes of the reef, this diligent worker forms rounded holes, having only a slight depth, but where the slope is gradual, the holes are much longer, running either directly inwards, or in a more or less winding way, being sometimes curved or bent upon themselves. They have often a length of four or five feet, and a width of three or four inches, the urchin apparently occupying the lower end of the elongate holes.

Whether the process by which the boring is accomplished, in this special case, is chemical or mechanical, it is very certain that this sea-urchin is able to resort to the latter means at times, for its excavations are common in the trap and gneiss rocks of many parts of the coast.

The sea-urchin holes, enlarged by the action of the surf, give rise to cavities and irregular pools on the surface of the reef, and these are deepened and widened by the dissolving action of the water left stagnant in them at low tide. But nullipores, barnacles and tube-building worms also live upon the surface, in immense numbers, and construct a very hard and durable substance which, to a certain extent, compensates for the loss of material caused by the sea-urchins. The barnacles and worms build up little walls of limestone around the mouths of the holes and between them, keeping them for a time more or less separated and perfect; but these walls are being constantly broken away, together with much of the surrounding material, resulting in the formation, over most of the outer slope of the surface, of a multitude of irregular, shallow pools, whose edges are protected by the same growth of barnacles and worm tubes. Many projecting masses, also capped with the hard limestone coating, are left standing in the pools, and wearing most rapidly below, they produce mushroom-like structures, which are very characteristic of the outer surface. They reach to the same height as the margins of the pools.

Ordinary sea-weeds grow luxuriantly on the outer edge of the reef, but they are of slight importance compared with the calcareous nullipores, which live in the full face of the surf and form, over large areas, a crust of a foot or more in thickness. Thus the barnacles, worm-tubes and nullipores combined, aid very materially in protecting the reef from wear, but the good they do is more than counterbalanced by the harmful action of the waves and sea-urchins, and, unless the latter are in some way exterminated, they will eventually work much mischief to the harbor of Pernambuco.

The inner slope of the surface of the reef differs from the outer, in not possessing those features which result from the actions of the sea-urchins, and also in being without the nullipore crust. It is generally characterized by a series of shallow basins, *lying* one below the other along the slope, the rim of each being

protected by barnacles or worm-tubes. These basins are sometimes several feet in diameter and a foot or more deep, and are often very irregular. Prof. Hartt has compared them in appearance to the basins formed by the hot springs of the Yellowstone valley; but while the latter have been formed by deposition, the former result from wear.

Having now finished our rather detailed study of the reef where it is most perfect, we must proceed farther south and see how it terminates. Nearly opposite the mouth of the river described in the first part of this paper, we find a small channel running underneath the sandstone of the reef, and through this there is a constant movement of water. At the sides large blocks have been dislodged, and, tumbling down, have reduced the width of the upper surface to about thirty or thirty-five feet. It thus becomes evident, as has been otherwise proven, that the sandstone reef rests on a very insecure foundation of soft material, which the water has washed out in places, forming covered passage-ways through which there is a strong current, varying in direction according to the time of the tide. Engineers, in boring through the rock, came to loose sand underneath, demonstrating that the structure we are dealing with is only the consolidated capping of a long bar of sand.

To the south of the channel just described, the reef has been much excavated, not only by the waves but by quarrying; this unwarranted destruction of the only object that gives to Pernambuco its prominence as a commercial city has, however, been stopped, and a breakwater has been constructed at this point, but it is now much out of repair. Around the Ilha dos Pinhos the reef curves slightly outwards, and then, bending westward, approaches gradually to the shore, which it skirts for some distance as a narrow line of rocks, almost lying upon the beach. Another small reef begins to the south, and running obliquely, finally joins the beach.

This closes our imperfect description of the reef as it appears at low water; at high tide, on account of the shallow water without, it is played upon by a very heavy surf, which sometimes rolls completely over it, and wave after wave, rising above the outer edge, bursts high into air on striking the artificial wall at the north. During spring tides the water is much agitated within the reef, but not enough to endanger the shipping.

As a result of his careful study of the Pernambuco reef, and of many others of similar character, some of which we will mention farther on, Prof. Hartt has given us the following conclusions regarding the mode of formation of this class of structures:

It is very evident that they are not the out-cropping edges of beds of sandstone, extending out from the shore, as some have supposed, but only narrow strips of stone of slight thickness, formed in exactly the same position in which we see them to-day, that is, just below the level of high tide. They have resulted from the solidification of beach materials, or sea beaches, by carbonate of lime carried into them by the percolating waters. This action goes on from the level of mean high tide to a variable, but only slight, distance below low tide mark, and has only a limited horizontal extension. By the after encroachment of the sea, aided by rivers flowing behind them, these consolidated beaches have often been separated from the main shore as distinct reefs; but sometimes this latter action has not taken place, and the hardened layer retains its normal position upon the beach.

The agencies concerned in the formation of these hardened beach deposits are mostly very simple ones, many of which can be witnessed by any person visiting the sea-shore. The slope of a sand-beach varies according to the size and character of the sand-grains composing it, the exposure of the coast and the height of the tides. When a wave strikes upon a beach it rushes up the slope in a sheet of foam, carrying with it a quantity of sand. As it returns the sand is spread out over the surface in a thin layer. In this manner a regular lamination, dipping at a more or less even angle, is produced in the material composing the beach. But this regularity is often much disturbed by storms, when the beach may be broken into by the waves and much of its material redeposited at quite different angles.

If the land back of the shore be very low, the beach may form a simple narrow ridge, over which the waves completely break at high water, carrying and depositing sand on the inner side of the beach, where the dip of the laminæ will of course be landward. Ordinarily, however, a ridge of sand is formed behind the sea-beach, above the reach of the tides, being partly due to the action of the surf during storms, but mostly to the winds. Such a beach-ridge as this accompanies most of the Brazilian beaches, which latter, on account of the exposed character of the coast, are formed of quite clean sand, consisting mainly of rounded

siliceous grains, with broken or perfect shells and finer calcareous particles, derived from shells, corals, stony sea-weeds, etc.

The action of the tides is not limited to the surface of the beach, but this, from its porous character, absorbs a certain amount of the water. At low tide the beach just below high tide level is wet but not soaked with water; going downwards, however, we find the beach becoming gradually wetter and wetter until it is completely saturated, producing little rills which run down the surface. With the rise of the tide the level of complete saturation also rises, and when the tide is high the upper part of the beach, for some distance above high tide mark, is completely charged with water, thrown upon it by the waves. A constant movement of water is thus produced in the interior of a beach, but on account of the friction against the grains of sand, this movement can only extend over a comparatively slight width, at least in the upper portions of the beach, which are under the water for only a few hours each day.

Now sea-water, in many parts of the world, and especially within the tropics, is very highly impregnated with bi-carbonate of lime, and this solution, from evaporation or other causes may deposit its lime in the form of a carbonate, which acts as a cement. Where evaporation goes on over a beach wet with sea-water of this character, the surface materials may become consolidated, as occurs at the Abrolhos islands, on the coast of Brazil, and elsewhere. Not only, however, may the upper sands be soldered together, but the hardening may even go on below the level of the sea.

On the Brazilian coast, the surfaces of the beaches are seldom hardened during the ebbing of the tide; but under the hot tropical sun and strong prevailing winds, there must be, in the upper part of the beaches, a concentration of the calcareous solution, which, on sinking downwards to the level of complete saturation, tends to deposit its carbonate of lime as a cement, uniting the grains of sand. The water from rains, percolating through the beaches, may also bring lime, arising from the dissolving of shells and corals in the upper layers, and lagoons, which frequently lie back of the beach ridge, may contribute to the same result. It is evident, however, that the work is mostly done by the sea-water, and that this agent, under certain conditions, has the power of solidifying sea-beaches to a variable distance inland, and to a depth varying from about high tide level to a few feet below low tide level.

If a beach be growing rapidly, or if it is being rapidly worn away, solidification cannot take place, because it is only over a stationary shore, that is neither receiving new accumulations of sand nor parting with its old, that enough time is granted for the accomplishment of this result. Therefore, consolidated beaches must be the exception and not the rule on the Brazilian coast, where the shore is undergoing much change nearly everywhere, and as sandstone reefs seem to be confined to that single country, it must be that there alone are the proper conditions attained for their formation. The hardening appears to extend from the outer side of the beach inwards, and from below upwards, as new reefs usually lie on the lower and outer part of the beach; the younger reefs are also softer in texture than the older, more-finished ones.

It is probable that many of the ordinary Brazilian beaches are solidified below the surface, but until something happens to uncover them, it is impossible to determine the fact. Reefs in process of formation are to be seen on the coasts of both Pernambuco and Bahia, and at Porto Seguro; in the latter province, there is a double reef, the outer one being the wreck of an unfinished structure, the inner still undergoing solidification.

Prof. Hartt was led to believe, from his earlier studies of the Brazilian stone reefs, that a slight elevation of the land was necessary to account for their present position; but his later studies proved to him that such an hypothesis was wholly uncalled for, and that none of the reefs reach above high tide level, or at the most above the level to which a beach is saturated with water at high tide.

Statements have been published that a certain amount of upheaval must have occurred to produce the supposed strong seaward dip of the laminæ of the sandstone; but nowhere, excepting on edges where blocks have been undermined and tilted up, is the inclination greater than might obtain on a sand-beach. To suppose an upheaval to have effected these narrow lines of reef, tilting the strata evenly in one direction, and no part of the neighboring coast, is a geological absurdity. The reefs follow the general trend of the shore, and are more or less curved, but generally straighter than the beaches immediately back of them.

Having shown that the curious reef at Pernambuco, which for many yea[illegible] omplete puzzle to explorers, has been formed throu[illegible] f very simple forces, in part working upon

every sand-beach in the world, we will hastily glance at the other evidences of the same phenomena on the Brazilian coast.

The northern-most consolidated beach examined by the Geological Commission, is near the mouth of the Rio Parahyba do Norte, where, to the south of a fringing coral reef, there are traces of a short and imperfect stone reef lying upon the shore. Stone reefs have, however, been recorded from north of this point by other observers, but they have never been described; one is situted at the mouth of a small river, about eighteen miles north of the Parahyba do Norte, and another lies in front of the Rio Potengy, in the province of Rio Grande do Norte.

Directly to the south of Cape Sto. Agostinho, in Pernambuco, is the most perfect stone reef discovered; it is almost absolutely straight, its northern end being separated from the cape by only a narrow break or bar, encumbered by loose blocks of reef rock. The land back of the reef, being very low, has been swept deeply away, forming a broad and very shallow bay. The inner edge of the reef is honeycombed and as irregular as that of a coral reef, while the shallow basins of the median and inner portions of the surface are much developed, forming regularly terraced plateaux.

At Rio Formoso, in the same province, there is another stone reef, reaching only about three feet above mean low tide, and not having a great length. The joints dividing the reef-rock are often filled in with sand, which has sometimes been solidified. On the island of Santo Aleixo, not far distant from Rio Formoso, is a small reef of soft texture, lying alongside the beach, and other imperfect reefs also occur in this vicinity on the main shore.

Nowhere near the city of Bahia do we find perfect sandstone reefs; but at the mouth of the bay of Bahia, close to the lighthouse on the outer shore, and on some of the inner shores of the bay, layers of consolidated material occur, capping the beaches and at times covering quite extended areas. They are often composed of very coarse materials and contain many shells, and illustrate beautifully, in many cases, the irregularities of beach bedding.

On the western side of the same bay, at Porto Santo, there is a curious example of consolidated beach structure, the only instance of the elevation of such material of which we are aware. At this place we find a cliff back of the beach, having a length of about 1,100 feet, and a greatest height of about thirteen feet, and composed almost entirely of sand and gravel, cemented by lime into a sandstone. The lower part of the cliff is very hard

in texture, and contains numerous fragments of corals and shells, the latter being frequently found entire. Many of the species of both exist in abundance throughout the bay. The upper part of the cliff is of almost pure sand, and has been so incompletely hardened as to crumble readily between the fingers. The amount of calcareous material in the lower portion is very great, and it is said to yield a good quality of lime on burning.

Whether this cliff belongs to the same class of structures as the reefs or not, it is, at least, composed of the same materials, and must have been formed in about the same way. Its present elevated position—for high water reaches only slightly above its base—indicates that the shore has been raised at this point to a height nearly equaling that of the cliff. What gives an increased interest to this locality is the presence of a low kitchen-midden, only two or three feet thick, which overlies the entire cliff. It is composed of a dark-colored, sandy earth, packed full of the shells of the edible mollusks of the bay, with a few scattered bones, and occasionally a human skeleton.

The stone reefs of the southern part of the province of Bahia, have been very fully described by Prof. Hartt, in the "Geology and Physical Geography of Brazil." The principal ones are those of Porto Seguro and Santa Cruz, both being similarly situated and of about the same character. The former is the larger, and, beginning in front of a small bay formed at the mouth of a river, runs southward, skirting the shore for a long distance. In general structure it is like the Pernambuco reef; the outer edge has become very jagged, from the undermining and falling down of blocks. But below the level of low water, the reef-rock extends seaward a hundred feet or more, forming a very shallow tract, over which one may wade when the tide is out. The inner edge is much thinner than the outer, being often overhanging, and it is flanked by a sloping bank of mud. The surface is of very uniform height, but quite rough, and interrupted by cracks and pools, which teem with marine life. From fractures at the end, it is apparent that the hardening has taken place to a depth of several feet below low tide.

At Gaurapary and Barra Secca, in Espirito Santo, and in their vicinity, are several imperfect reef formations, similar to many already described; and at the Abrolhos islands, as before stated, the sand and shingle beaches are often firmly consolidated by a lime cement.

ROB: A BIRD BIOGRAPHY.

BY REV. SAMUEL LOCKWOOD, PH.D.

IN the clearer light of these latter days, a higher value has settled on the so-called small things of nature. To-day the student thinks he finds in the lower realms of animate beings a psychology, perhaps also a morality, and a self consciousness, which he asserts are the "baby figures" of better things that were ordained to come. It may be that Mrs. Partington spoke wiser than she knew when she said; "Human nature is human nature, if you do find it in a cow." And though so lowly, how educable are these emotional and sensitive creatures! Could one know all about them, perhaps each would be found to have an interesting biography. Let us attempt to tell the story of a tame robin, *Turdus migratorius.*

Rob, for so we shall call him, was taken from a nest on Long Island. Though passed the callow stage, he was not fairly fledged. His pap was meal mixed with fresh milk, a point which he insisted on ever after. He was turned a year old when he became one of our pets, and very soon he had established himself in our affections. He was very exacting of attention—so demonstrative and familiar. In the very pertness of its humor the conduct of the bird seemed paradoxical; for though in its way almost beseeching your notice, it would, on your approach, assume a repellant attitude, with wings striking and bill snapping. But to witness the "high-jinks" of his fury, it was only necessary to intrude a hand into the cage, keeping the back upwards, and Rob would seem wild with savage gladness, for he would settle on it and peck away with his sharp bill at the knuckles as if he were picking into a big bonanza. Much sentiment is wasted about keeping birds in confinement. Does it not generally come from such as are intolerant of pets? "It is a deprivation of natural freedom." So thought the horse in the meadow, as he beheld the ass roaming in the unfenced sand lots. Even birds may have "hard times." Yes, I have known the free wild birds to be starved to death within the sound of a canary's song. But perhaps Rob was unsentimental, for it was plain that prison or not he liked his cage. In it he was at home, and well to do—away from it he was a-drift and unsettled. The door of the cage was sometimes left open for a little while, a proceeding which usually called

for large consideration on the part of the occupant. At such times he would look as quizzical as a knowing young barrister: "Want to get me out, hey? Ah, but possession is nine-tenths of the law!" Still, even wise folks may be inquisitive, and Rob was not above that weakness. He would stand on the door-sill of the cage and with those pretty hazel eyes take in the outlook. This done, with a gravity fitting the act he would step in again, and resume his uppermost seat—the top perch. Sometimes Rob would come out for a little while.

As a rule, excess of freedom is pretty sure to cause our pets to come to grief. The real giant grim of the birdies is Grimalkin; and he is everywhere. We had got lengthening Rob's parole with bad effect on his circumspection. In fact there was a slacking up of the usual bird prudence. One day found him missing. So Rob had run his parole! No, he had not. The pear tree was white with bloom, and he thought to enjoy himself in its branches. Alas, Grimalkin was hidden there, and the catastrophe was serious. We found the poor bird half dead, with a gory laceration of the breast. How he got himself out of the mouth of the carnivore seemed a mystery. But Rob had gone through life so far on his cheek, and my belief is that his escape was due to his plucky impudence. In his case the proverb had been emphatically true: "Familiarity breeds contempt." I had often taken him pettingly into my hands, when, not from terror but sheer temper, he would bite and scream like a vixen. He seemed to fear nothing. As for the cat and the dog they were nobodies whom he saw every day. Now, I have seen the wild robin when caught by the cat, and the victim was as resistless as a clod, in sooth, it was paralyzed with terror. With Rob the case, I think, stood thus: The cat had a hold on his breast with her mouth, but owing to the smallness of the branch which supported her, she had to use all her feet to keep her position although needing the fore ones to help retain her prey, for Rob, though badly frightened, kept his senses, and doubtless used his wings and bill to good purpose on the face and eyes of his grim captor, thus accomplishing his release. It was a long while before the bird got over that wound, which left an ugly though not dishonorable scar.

The bird had its own amusements. Is there not an instinct in whose manifestations our little girls are strangely like the birds?

In their plays how our children anticipate the cares and ways of motherhood—the nursing and the dressing of the doll, the make-believe keeping house, etc. A hundred times have I seen cage birds go through a "dumb show" of mimic nesting, fussing with laborious concern over a feather, or stick, or straw, or hair. I have seen Rob running about his cage with a bit of straw in his mouth, and uttering a conceity twitter, as if he were in live earnest, and saying to a supposable partner in the business: "Here, Mrs. Rob, is just the thing you want."

If one wanted to get Rob on a string, it was enough to give him, in technical parlance, the proximal end of a bit of grocer's cord, reserving to one's self a hold on the distal end. How perseveringly the bird would draw the cord into the cage, and with system too. Seizing it with its bill an inch or two would be drawn in, and a foot put on it, then a little more pulled in and held in place in like manner, and so on until the other end was reached. Now the fun began. Gently the coil was drawn from under the bird's foot; this would bother Rob, for though he was pretty fair on practical reasoning, he could not take a step in the abstract. With quickened energy he would go the thing all over again; and again he would find his labor slipping from under his feet. This at last would excite a spurt of temper, and the thing would be given up in disgust.

Owners of cage pets do not always reflect that birds of the Passerine group are the most delicately organized; hence they are often irritable. Coues has well called them fast livers, they so freely consume oxygen. Rob had a high temper. A trick, perhaps unwise but really amusing, was sometimes played on the bird. A bit of rubber or elastic cord was tied to one of the wires of the cage. Rob would seize it in his bill and pull, though but an inch long, the bird's efforts would stretch it to a number of inches, when just as he was pulling the hardest, it would fly back again, and Rob, to his dismay, would be set back too, with a recoil that fairly lifted him off his legs, and over his tail backward. In the matter of experience the bird never learned at the first lesson, but would keep on meeting the same mishaps, until badly beaten with his own petard, he would give it up as a bad job.

There may not be much dignity in it, but the boy does find some enjoyment in running backwards and forwards by a picket

fence, teasing the testy dog which keeps up with him on the other side. Often Rob had his disposition tried by some one rasping a finger along the wires of the cage. He would pursue the obnoxious digit, snapping his bill furiously, as only a bird can do. By and by would be heard a sharp involuntary "Oh!" telling that Rob had got in a good point on his tormentor, and thus closed the game.

Our robin often afforded matter for study and delight in those expressive attitudes of which birds only are capable, and which too effectually elude the artist's pencil. What high-wrought excitability and poetic expression appear in these movements. What barbaric defiance in the cresting of the crown feathers of the head, that queer furring up, or puffiness of the cheeks, indicating that the hearing is keyed to a strain; that jaunty setting of the head, and saucy cocking of the eye, for a bird never looks so knowing as when he looks sidewise—all this fills a hiatus where speech cannot get in. Even the tail adds to the action. Now comes a decisive chirp. A conclusion has been reached in the bird mind. Next is a series of rapid chirps, making a whirr of sound. This is the call-note of his tribe, for he has detected a turdite in yonder grove, and hark! the call is answered.

But what does Rob know of his clan? Well, some knowledge he has of inheritance, for there is both with birds and men a knowledge which cometh not with observation; some of their ways have come to him by descent. It is now March, and Rob has the spring fever badly, that migratory phrenzy which has set the whole tribe moving north. While the spell lasts he is impatient of home, and is as mad as a March hare. Some robins in that cherry tree have set him fairly wild; and even when there is neither sight nor sound of bird, that migratory impulse, that mystic call to move and mate, keeps the poor bird uneasy. Happily it does not last many days. By April he does something better than chirp, for he gets into a strain like the conjugal song of the robins. Through several days it is so low, soft and silvery, so tender and sweet; but this over the melody is set on a higher key, and becomes a volume of exultant rapture. He has now taken up an octave flute. In his dumpy moods he has been talked to pettingly so much, that he knows the words like a book: "Wake up, pretty boy! Wake up! Wake up!" The boys sing the words, again, and again. Then they whistle them. The bird

catches this little snatch of melody, and executes it in a clear distinct enunciation. This is Rob's best role. Pity that sweetness should ever cloy, but Rob did give us too much of a good thing. Through the summer months, an hour before daylight, on the highest key possible, came that piccolo strain, "Wake up, pretty boy! Wake up! Wake up!" Bob's cage was inside the window-blinds, and by the time the twilight was breaking up, generally several robins had visited the cherry tree near the house, attracted by the singer whom they could not see.

The prince of the mimics is the mocking-bird. But to some degree are not all the thrushes mimics. The cat-bird is really clever in this direction. However I own to a surprise on hearing that Rob had gone into the mimic art. Whenever our black-and-tan, Dick, heard his young master whistle an invitation to take a walk with him, the affectionate brute would almost lose his head in yelping gladness. It was a beautiful day in June, and Dick was seen acting as if half dazed, running up and down the yard looking for his master but unable to find him. Rob had learned the dog-call, and from behind the window-blinds was practicing his new accomplishment. The dog soon saw the trick and slunk away not a little abashed. We all felt that though funny, it was really mean of Rob. Our neighbor's fine hunter was bothered in the same way. Rob tried his hand on the call used by Madame to her poultry at feeding-time. The attempt did him no credit, perhaps for the reason alleged by one of my sons, that "the chickens didn't know enough to get sold." But with some folks failures are simply the preludes to success. Our mimic had grander things in reserve.

Rob's successful play upon Dick was not his only attempt at imposition. On one occasion the good lady of the house being up stairs came running down in great concern, there was such a cry of distress among the young chickens, "Peep! peep! peep!" in rapid plaint smote her gentle ear. To reach them she had to pass Rob's cage. Here she stopped short, and gave vent to an outburst of laughing indignation, for it was Rob, the rascally mocker, who was doing his best to set all the maternal hens at ears about their babies. Though somewhat perplexed, these elderly birds were not very badly taken in. At another effort Rob achieved a marked success; he imitated the cry of the mother-hen when the hawk is overhead—that low whirring note

of danger. All was consternation in the barn-yard. Away sped each callow brood to their own particular mamma, who, though unable to see any danger in the air, yet supposing the alarm to come from some watchful mother that did, instantly took her own charge under her wings. Rob's mimicries were generally perfect. In executing some of them he was so loud-voiced as to be heard a long way off. Persons at quite a distance have been attracted by these notes, and have called to see our "mocking-bird," and been much surprised to learn that it was "only a robin."

The senses of birds must be very acute. I would instance in Rob's case that of scent. He was extravagantly fond of fresh beef, and though in a different room, could tell the arrival of the butcher's boy in the kitchen, when he would scream with impatience. Little strips of raw beef were fed him. If when receiving one morsel he saw another in the fingers of his mistress, he would drop it on the floor of his cage and wait for the next bit with nervous impatience; and so would he do until he had secured all that his sharp eyes saw, which done, he ate these delicacies in a perfectly orderly way. How unlike a dog which swallows as fast as he can the meat given it. But Rob was particular, the meat so providently put on the floor of his cage was thus rendered dirty; the knowing bird would take it piece by piece and wash it in his water tub. This conduct showed the nearest approach to abstract reasoning that I ever saw the bird make. Many of the birds like this condiment of leisure with their food. How often have I seen a fowl pick up a grain of corn, then drop it and look at it, then pick it up, drop and inspect again several times, then swallow it, and all with no other logic in the matter that I could see, than to make the most of one's blessings. So with Rob, having got his store before him, he enjoyed it in a leisurely and sensible way. He was very fond of the larvæ which we used to find in chestnuts. Even these he could smell afar off, and would go into ecstacies, making a lively chattering talk, as one was brought to his cage. The presentation of a spider was a grand event. But as to earth-worms, he had a soul above all such. So far as Rob was concerned, the early bird was entirely welcome to them.

I think our pet must have been five years old when he had a hard time molting, and the result, too, was quite notable. When the large feathers began to come, two white ones appeared in the

tail. Oh, tell it not among his kith that Rob, the plucky and the impudent, shews the white feather! But leaving figure and coming to fact, the truth is, the poor bird was greatly distressed about it, so much so that he made up his mind he would not stand it, but would extract the offensive things, and at it he went. The tail was deflected so as to meet the head, itself turned under the perch; the bill then seized one of the craven feathers and pulled desperately. As if the perch were a trapeze, the bird swung fairly round, going over backwards and falling on the floor of the cage. But the feather had not come out. At it again he went in the same way, and with the same result. And this was kept up nearly an hour, by which time the tail had become all dyed with blood. At last the odious feathers were removed, and the poor bird, weak, bleeding and suffering, put its head under a wing and took rest. What shall be said to this? Was it pride, a certain proper self-respect? We cannot say. But this matter caused us a good deal of solicitude, for it was kept up some weeks, as the feathers would come in white. So at length the bird submitted in sheer despair. When the feathers came to the full there were two white ones in the tail, and as many in each wing. At the next molt the number of white feathers increased. When he was eight years old all the primaries of both wings were of a snowy whiteness, also the retrices, or large tail feathers, except the central pair which kept their normal dark color in bold contrast as lying on a bed of white. This certainly was a strange costume for a robin; in good sooth, his own mother would never have known him. In our eyes Rob, though in an eccentric costume, seemed a gay and elegant fellow.

This partial albinism, we believe, is occasionally found among the robins. But what is its meaning? Attacking the largest feathers of the tail and wings, it might indicate inability of the pigment cells to furnish color any longer at those parts of the plumage where the demand was the greatest. It is doubtless due to an exceptional atrophy of the secreting color-glands.

Our pets were usually divided round in the family. Rob was claimed by my daughter. It was a tender parting when with her husband she left for a new home in a great western city. And even Rob had no small share of our good-byes when taken to the car with the bridal pair. In his western home he was allowed enlarged freedom, his cage with open door being often set in the

garden. When his cage was hung under a tree by the side-walk, the pedestrians would stop and wonder what bird that could be with so strange a plumage and so novel a song. When free in the garden Rob would have a good time of it, occasionally finding a dainty insect. But the dear fellow was getting old. Nine years is rather high for *Turdus migratorious*, and his appetite was becoming a little unnatural. He found a piece of twine, and by persevering succeeded in swallowing it. That was the worst string ever Rob got on. That western investment was the death of him.

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ON THE MORPHOLOGY OF THE SEMICIRCULAR CANALS.[1]

BY FRANCIS DERCUM, M.D., PH.D.

IN biology we meet, at every step, new and interesting questions. How this or that structure arose, what this or that fact means, are the problems which continually present themselves. The data are few and scattered, yet the attempt to arrange them in some logical manner is at least justifiable, and though our success may be doubtful, we at least take a step in the right direction.

Such an attempt let us make in regard to the semicircular canals. Under the idea that these structures, like all others, were formed for a special purpose—were designedly made to meet certain ends—a great variety of functions have been assigned to them. Viewed in the light, however, that every organ is the resultant of certain definite and interacting forces, the mere question of actual or present use becomes a secondary one. Let us see what the various facts I have collected seem to point out.

Before we attempt to understand such a complex organ as the ear, it would be well to look over the field of zoölogy to see whether we cannot find other and simpler organs of sense, which may perhaps give us the right clue. Such organs I believe to be the so-called mucous canals or lateral lines of fishes and amphibians. These structures, I need hardly say, have been ably demonstrated by Leydig, F. E. Schulze and others to be sensory. They consist essentially of small areas of nerve-epithelium arranged in linear series along the sides of the head and body, having hair-cells continuous with nerves and being in every way comparable

[1] Read before the Alumni Association of the Auxiliary Department of the University of Pennsylvania, March 28, 1879.

to the maculæ acusticæ of the ampullæ and vestibule. They have received as yet no specific name. Leydig simply uses the expression "nerve-buttons" (nervenknopf), and F. E. Schulze "nerve-hills" (nervenhuegel). In the adult forms of almost all fishes, these structures are inclosed in a continuous canal formed in the epithelium. To this fact we will return again.

The function of these organs appears to be to appreciate mass movements of the water, and more particularly vibrations which have longer periods than those appreciated by the ear.[1]

Besides the similarity in the structure of the maculæ of the lateral lines and the maculæ acusticæ, the following facts indicate a close relation between the two sets of organs. In the first place, in accordance with the general law of the development of sensory structures,[2] both the ear and the mucous canals are developed from the epithelial layer of the embryo, namely, the epiblast. Secondly, the side organs of the head are supplied by the fifth pair of nerves, while those on the body are supplied by the lateral nerves, which in turn are made up to a greater or less extent of the fifth. Now, a fact, the significance of which can never be over-estimated, is, that in the skate the auditory nerve is a primary branch of the fifth.[3]

Again, the organ of hearing is surrounded by bone really belonging to the ectoskeleton, but usually becoming incorporated with the bones of the cranium. In the same manner the side organs of the head are surrounded by bones belonging to the ectoskeleton, and likewise becoming more or less incorporated with bones of the skull and face. The supratemporals, suborbitals and lachrymals are examples of these. Even in the side organs of the body the same tendency to the persistence of bone is manifested by the occasional presence of bone corpuscles and even of cartilaginous or osseous grooves or canals. Now, while I recognize in this comparison only a very general fact, I still think that the parallelism between the bony support of the ear and the bony supports of the side organs is far greater than between the petrosal and the sclerotal.

Let us now turn to the development of the mucous canals,

[1] See Archiv f. Mikroskop. Anat., VI. F. E. Schulze, Ueber die Sinnesorgane der Seitenlinie bei Fischen u. Amphibien.

[2] See Am. Naturalist, Sep. No., 1878. The Sensory Organs, by the writer. Also Cosmos, 1878, Oct. and Nov.. Die Enstehung des Sinneswerkzeugs, by Professor Haeckel.

[3] Owen, Comp. Anat. of Vertebrates.

and see how much of general application can be gleaned from the facts. In teleost fishes the side organs first exist as mere cellular elevations[1] projecting into the water and having the percipient structures, the hairs, protected (generally, not always) by means of a delicate hyaline cylinder open at its distal end. In most cases this stage is transitory. Above and below the elevations, the epithelium of the surrounding skin becomes raised, forming a groove which is finally converted into a canal. Thus these elevations or maculæ of the side organs become enclosed by a process somewhat analogous to the involution of the ear.

In Elasmobranch fishes, however, another method is pursued. The lateral line appears already in the embryo as a fully formed canal, and, instead of being produced by an inflexion of the epiblast, is formed directly by being hollowed out in the substance of the same.[2] This departure from the general method of the development of sensory structures is an illustration of an important fact dwelt on by Herbert Spencer, namely, that the processes pursued in the development of the embryo are by no means the exact repetition of those which occurred in the evolution of the race. In many respects the processes of embryology are shortened. The integral parts or molecules of many structures tend to assume directly the relations which they occupy in the adult form, without passing through those intermediate stages which were successively traversed by the ancestors of the races.

This marked difference between the development of the lateral lines of Elasmobranchs and Teleosts is in harmony with several other interesting facts. We would naturally suppose that an organism in which a comparatively complex structure is produced by the direct method, is relatively both older and higher than one in which the same organ is produced by the indirect method. In the present instance this is the case. The Elasmobranchs constitute an order of fishes of vast antiquity, making their appearance already in the Upper Silurian, and being, therefore, among the oldest fishes known. Again, they constitute a very high order being perhaps, with the exception of the Dipnoi, the highest. They are even related in some respects to amphibians. The Teleosts, on the other hand, are ordinarily regarded as the representatives of the piscine type; that is, as presenting preëminently those characters which constitute a fish. Secondly, the Teleosts

[1] The nervehills of F. E. Schulze.

[2] See Balfour's Monograph of the Development of Elasmobranch Fishes, 1877.

are an order which is comparatively very young, not making its appearance until the Cretaceous period. Observe how these facts accord with the development of the lateral line. In Teleosts the involution of the maculæ or nervehills of the lateral system and the consequent formation of a canal, does not take place for days and even weeks after the young fish has left the egg. In one instance, *Gobius minutus*,[1] it does not take place at all. In Elasmobranchs, however, as stated, the canal is already formed in the embryo.

Surely such a harmony of facts must be of significance, and they must open our eyes very widely with regard to the relation between embryological and race development, or, to use the words of Prof. Haeckel, between ontogeny and phylogeny. Doubtless in the primitive Elasmobranchs, or in their ancestors, the development of the mucous canals was similar to that of the Teleosts of the present day, but, in the countless repetitions during countless ages, the process was shortened and made, as we find it, immediate and direct.

Now, what bearing have such facts as these on the correct understanding of the embryology of the ear? Let us see.

Can we suppose that a structure as old as must be the organ of hearing, is still formed in the embryo by repeating the various stages once traversed by our remote ancestors? Would it not be more philosophical to expect that this organ is now produced by a process more or less direct? To this latter view I think we must, by necessity, incline.

The embryology of the ear may be briefly stated, as follows: It first makes its appearance as a depression of the epiblast in the neighborhood of the hind-brain. This depression gradually deepens until, by the coalescence of its edges, it is converted into a closed cavity. This cavity then rapidly enlarges and certain dilations or protrusions of its surface into the surrounding mesoblast take place. These protrusions are severally converted into the semicircular canals and cochlea. In the case of the semicircular canals each dilatation becomes flattened, and, by the meeting and coalescence of its opposite walls in the middle, its peripheral portion is converted into a tube, both ends of which remain permanently in communication with the primitive vesicle. The cochlear protrusion undergoes no such transformation but is simply prolonged, forming the true membranous cochlea or scala

[1] See F. E. Schulze, loc. cit.

media of mammals; but with this we have at present nothing to do.

Evidently the first stage of the development of the ear, the process of inflexion, belongs to the indirect method, but the fact that this process is still so pronounced, and the fact that the otic vesicle when once shut off from the epiblast rapidly enlarges, so that the area of the enclosed surface is relatively very great, would indicate to my mind that in our remote ancestors, this process of inflexion was very marked—that it was extensive, involving a a comparatively large area, and bringing about great modifications of structure. The tendency in the constant repetition of this process would be to diminish its relative importance, *i. e.*, to make it constantly less and less pronounced. Probably, therefore, the amount of surface actually inflected in the embryo is small compared with the area inflected in the process of ancestral development. To this we will presently return.

The special parts of the labyrinth appear to be formed by a direct method. This would, of course, as we have seen reason to believe, not exclude the possibility of an indirect method having obtained in our remote progenitors.

Having now compared the various methods pursued in the development of the mucous canals and the ear, let us recall a fact which has not yet been brought into sufficient prominence, namely, that the structure of the mucous canals and that of the semicircular canals is very similar. In 1850 Leydig[1] already noticed this fact, for he compares a semicircular canal and its ampulla with a mucous canal and its "nervebutton." Both structures consist of connective tissue lined with epithelium, and the "nervebutton" of one corresponds to the macula acustica of the other. The analogy seems complete.

Would it now be too hazardous to suggest that two organs which are so closely related in structure, which present such significant facts, as regards nerve supply and embryological development, are related genetically? Such a supposition would evidently not be inconsistent. Let us see how it may have been brought about. In an organism provided with a general apparatus for the perception of vibrations, evidently the first thing that would take place would be a specialization of certain portions for certain classes of vibrations. This is what may have been the case with the lateral canals and the ear, each being a specializa-

[1] Mueller's Archiv.—Schleimkan. d. Knochenfische.

tion in its own peculiar direction.[1] The fact that the involution of the side organs in Teleosts does not take place until the organism is already far advanced towards the completion of its development, and the fact that the mucous canal in the embryo of Elasmobranchs does not appear until the epiblast has been differentiated into its two layers, both imply that the side organs had for ages existed as mere "nerve-hills," or nerve epithelium, projecting into the water, and this renders our idea not only possible but probable. In the course of the evolution of the ear the first differentiation of structure that occurred may have been as follows: Certain of these areas of nerve-epithelium or sensory maculæ, may, for functional specialization, have become enclosed in canals. (The great functional advantage of this form of involution over the closed vesicle, we shall presently see.) Now, for still greater specialization, the whole area containing the canals with perhaps one or two maculæ not yet enclosed, may have undergone a general process of involution and thus given rise to the vestibule and semicircular canals.

This view of the evolution of the ear is favored by the fact that the semicircular canals are *constant structures in all vertebrates!* Again, their number is always the same, namely, three, with but two exceptions, which may be easily explained. I refer to the Myxines which have but one, and the lampreys which have but two. Probably no naturalist who accepts the theory of evolution, looks upon the selachians or any other existing order of fishes as ancestrally related to the other vertebrates, and even the structure of the Marsipobranchs indicates that they belong to an *early differentiated* and highly aberrant type.

In studying the gradual development of the ear, palæontological evidence, unfortunately, cannot come into play. It is too fragmentary. The very first vertebrates that we find are already fishes of a high degree of development.

Let us now see to what views of the functional value of the semicircular canals, the above discussion leads. The first question that arises in our minds is, what is gained by the involution of the sensory maculæ? And secondly, why should this process have resulted in the formation of canals? Why did not each macula become enclosed in a separate cavity? Probably the benefit derived by a delicate sensory structure from the formation

[1] In this category it would be no more than just to include such structures as the *sensory ampullæ* of sharks and rays and the *Savian vesicles*.

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machine, the various functions of which we wished to determine. Now, what would we think of a man who would plunge a knife through crystal, dial, mainspring and all, to find out how the thing worked. Is the proceeding in the case of an animal any less absurd? Is it more encouraging to know that the machine with which we are dealing is infinitely more complex, and of the fundamental truths of whose construction we can only gain vague and fragmentary ideas?

In order to understand a complex organ—if, indeed, the attainment of such an end be possible—I believe that we must cast about for the most widely scattered facts, and then view these in the broadest possible light. I believe, therefore, that the only way to understand an organ for the perception of sound vibrations, is also to study organs for the perception of allied vibrations, and then to compare the various principles involved in the development, structure and function of each. By the pursuance of such a method in the present instance, the conclusions which seem to be pointed out, are, first, that the chief significance of the semicircular canals is *morphological*, and secondly, that their functional importance, though considerable, is secondary. If, in the above discussion, I have merely raised this view of their nature to the degree of a probability—which is the most that circumstances allow—my object is accomplished.

Addendum.—After the reading of the above paper, Dr. A. J. Parker offered a suggestion with regard to the function of the semicircular canals which makes the parallelism between these structures even more apparent. His view, which he permitted me to append, is as follows:

He says that the maculæ acusticæ are very probably situated in just those parts of the labyrinth on which the sound waves impinge with the greatest intensity. This being the case with the maculæ of the ampullæ, the sound-waves probably enter the ampullar ends of the canals with much greater force than they enter the non-specialized ends. Consequently, when interference takes place, it occurs in or near these non-specialized ends, *i. e.*, where there are *no acoustic spots!* Dr. Parker looks upon the semicircular canals as so many conduits to carry off vibrations after they have impinged on the maculæ of the ampullæ. This would make their function exactly analogous to that of the lateral canals.

Dr. Parker's view also explains why each semicircular canal has but *one* ampulla, and why this should be situated at the *end*, instead of other parts of the tube.

TEXAS IN ITS GEOGNOSTIC AND AGRICULTURAL ASPECT.

BY J. BOLL.

HAVING resided for several years in Texas, during which time I have constantly been engaged in scientific researches, I shall, in this article, aim not so much at a geological and geognostic description of the country, as attempt to present results already made known by others, and to give a slight view of my own observations in the same field. I shall not undertake a description of rocks and minerals heretofore found in Texas, nor enumerate animals already known as extinct or as still existing; but rather from the nature of the soil and the constitution of the mineral kingdom, draw my conclusions as to the fertility and products of the different parts of the State.

Of the various publications by other persons on the geologic and geognostic conditions of Texas, the following are known to me:

1. Texas, with special reference to German emigration and the physical condition of the country, as described after personal inspection by Dr. Ferdinand Roemer, together with a scientific addendum. Bonn, 1849.
2. The Chalk-formations of Texas, and their organic contents, by Dr. Ferdinand Roemer. Bonn, 1852.
3. Exploration of the Red river, in 1852, by Rand. B. Marcy, in which the north-western part was geologically described, by Geo. B. Shumard.
4. The Annual Reports of State Geologist Buckley.
5. The Map of Texas, by A. R. Rössler. 1874.

The geographical character of Texas, as Roemer correctly remarks, divides it into three districts, more or less sharply defined. These are:

1. The Lowlands, along the whole coast, from the Sabine to the Rio Grande. They vary in width from thirty to a hundred miles, rising from three to a hundred feet above the sea, and are really only a continuation of the coast-lands of Lousiana, Mississippi and Alabama, and therefore belong to the same diluvial and alluvial formations, being almost wholly composed of clayey and sandy deposits. However, it is not alone the rivers coming from the interior which collect and bring down this material, for the sea also contributes its part. As proof of this, we find in the soil, not only the remains of marine animals, but the animal and vegetable world still extant gives evidence thereof. Here, not

only on the coast but in the whole region, we find those plants and insects living near salt-water only. The long narrow islands lying along the coast of Texas must necessarily, on account of their situation and physical condition, be considered as parts of the Lowlands.

2. The Hill country, or Uplands. This consists of the prevailing level and hilly region between the lower coast-range and the higher and partly rocky highlands beyond. Its width is from a hundred and fifty to three hundred miles, about one hundred to one thousand feet above the sea. According to its geological composition, it partakes in equal parts of the tertiary and secondary formations. The fertility of its soil is exclusively due to the composition of these formations, hence within it are embraced the fairest and most prolific portions of the State. Large, extensive prairies are situated in the west, with strips of timber along the creeks and rivers, also large and small forests diffused here and there, but composed wholly of post-oak. The eastern portion is almost entirely covered with forests of a great diversity of timber.

3. The Highlands. These arise behind the rolling hill-land, beginning in the west on the Rio Grande, where, at its confluence with the San Pedro, it suddenly turns its eastern into a south-eastern course. Thence the boundary extends due east to the great sources of the San Antonio; thence north-east to Austin; and thence due north it reaches the Red river near the mouth of the Little Wichita.

From the Rio Grande to Austin, the boundary between the Hill country and the Highlands is well marked and sharp; while from the latter point to Red river the transition is more gradual and more difficult to define. The highest places in it rise scarcely 2500 feet above the sea, excepting the Guadalupe mountain, west of the Pecos river. In the north-west part of the State, towards New Mexico, the elevation slowly increases towards the Rocky mountains. No higher mountain chains are at all to be seen, and this region has rather the character of a high table-land. The inequalities arise more from the excavations of valleys and ravines, while the elevations generally maintain the same level. In its geological character it is greatly diversified, belonging, as it does, to the tertiary, secondary and primary formations. In very many places the soil is very dry, sterile and rocky, especially the

valleys in the south, presenting steep and rocky entrances, rarely widening into fertile plains. All the principal rivers of Texas rise in this division, which is but sparsely settled and but imperfectly explored and known.

If now we take under review the formation and composition of the soil of these different parts of the State, the following will be the result as to their fertility and products:

In general we distinguish three different kind of soils—sand, clay and limestone—in the first, sand or silica predominates, in the second, clay, in the third, carbonate of lime. Neither of these constituents alone is sufficient to produce a vigorous growth of plants; that this is the case with sand is proved by the great deserts of Asia and Africa. When sand constitutes more than nine-tenths of the soil, vegetation cannot flourish; yet all soils require a certain proportion of sand, because every plant needs some sand for its growth; for cereals especially this element is indispensable. The clay soil has also its defect, it is too tenacious, so that the roots cannot spread out; it retains water too long, and when it dries it hardens into tough lumps; it has, therefore, precisely the opposite faults of sand, wherefore a proper intermixture of the two proves advantageous. A soil consisting solely of lime varies too violently in moisture and dryness; lime is, however, as indispensable for the nutriment of plants as sand, so that mixed in proper proportions with sand and clay, it proves itself highly advantageous in every respect; hence soils composed of sand, clay and lime are, without doubt, the most fertile.

Now, as regards Texas particularly, its sandy soil was mainly derived from the sandstone of the tertiary period, whilst its clay and lime soil deposits came from the tertiary and Mesozoic ages.

The soil of the Lowlands is, through the accumulation of sand, clay and lime, brought into a mixture very beneficial to cultivation, but owing to the presence of salt, and still more to its level surface, which hinders the discharge of water, it is not adapted to every kind of cultivation, wherefore wheat cannot be raised, whilst Indian corn, sugar-cane and cotton succeed admirably. The entire Lowlands are not yet extensively cultivated, and its more general culture depends upon a thorough system of drainage. The condition of the soil is everywhere the same, neither stones nor rocks are to be seen.

In the Hill-country we find the sandstone, and the sand and

clay deposits of the tertiary formation in vast extent, and the peculiarity of it is that these places are, throughout, covered with forests, indeed we may safely conclude that wherever extensive forests are found in elevated positions, they arise from a tertiary foundation. Thus the whole forest-clad parts of Eastern Texas, from Red river down to the sea-coast, consist of these formations, the upper and lower cross timbers of North-western Texas, like the post-oak forests situated in the middle and southern, rest throughout upon tertiary formations. Since now the soil there, mainly through the influence of the glacial era, was derived from sandstone and sandy-clay deposits, it is, therefore, less adapted to the cultivation of plants, having obtained a large share at the same time through a considerable proportion of iron, as we shall see later; yet along creeks and rivers are found here and there places fit for cultivation. In the first years of culture, plants flourish generally quite well; but the strength of the soil is soon exhausted, which has strikingly exhibited itself in parts of Louisiana bordering on Texas, this side of Red river. This region has been for a long time thoroughly cultivated, and at this time has only two-thirds of its former extent under culture. Wheat does not succeed in this soil, and cotton is mostly only one to two feet high; corn is weak in the stalk and the ears are small; fruit-trees alone flourish there, viz: peaches and apples, since these trees are enabled to send their roots deep into the ground. Pines, which grow best in sandy regions, diffuse themselves to a great extent through the forests. Since then, by means of forests, we can decide the tertiary foundation of the soil, so in the same way we may state that open prairies and places covered with mesquite trees, indicate that the soil rests upon secondary formations. There again the soil is formed of sand, clay and lime, through the operation of the glacial era, and mingled together in so advantageous a manner that it presents all those conditions on which depends the perfect development of all cultivated plants. This division embraces that part of Texas which promises to become so large a source of food such as no other State of the Union possesses, even such as can be found in few portions of any continent. Again, in this same division is that region of peculiar importance in which naked rocks appear on the surface, neither to a small nor great extent immediately after the tillable ground has been broken up by other causes.

Such a wholly continuous area, more than one hundred and twenty miles wide, and over two hundred miles long, lies in the northern part of the Hill-country of Texas. It forms a long rectangle, of which Dallas county is nearly the center, and this is the reason why this division, and especially the city of Dallas, have so rapidly grown in importance, and this proves at the same time with what keen foresight railroad magnates have stretched their iron roads through this section.

This division is, however, penetrated in its north-western part by the so-called Cross Timbers, two strips of forests from eight to ten miles wide, the soil of which consists of the tertiary elements, but their intermixture through the physical influences of the glacial period, since the extent was not very great, became much superior to that in Eastern Texas. Besides, it constitutes only a very small part of the division under consideration, and supplies at the same time, to the adjacent prairies, convenient and adequate material for fencing and fuel, which only in few places has to be procured from considerable distances.

In the southern and south-western portion of the Hill-country, as far as the Rio Grande, the soil is also composed of sand, clay and lime, yet, as in the northern part, it is more frequently interrupted by tertiary clay and sand, but much more, and more injuriously to agriculture, is the ground filled with hard, reddish flint stones, from the size of a pigeon-egg to that of the fist. These originate in the Highlands north of it, on one side of the primitive mountains arising there, and still more from the extensive chalk hills. This chalk formation of the Highlands is of a sandy character, hard, and enclosing a great number of sand and flint concretions. After the drift period they remained scattered in every direction, and this readily explains why these concretions are found not only in river beds but also on those higher localities surrounding the valleys, and particularly on hills. The soil of this part of the Hill-country is here and there so filled with these stones that it is useless to undertake a thorough culture of it. Although these places often interrupt the fertile soil, yet the latter comprises a considerable area, and it is especially the river-bottoms which in the southern part of the Hill-country possess an immense productive power. In the valley of the San Antonio river, almost the entire bottom of the valley can be irrigated for a great distance, yet this system of irrigation, constructed by the

Spaniards many centuries ago, has already so exhausted the soil of loose, light mineral material, that a rich crop can no longer be reckoned upon excepting here and there.

In this connection the following points may be mentioned. Till now it has always been a problem where the great sources of the San Antonio river, as also of the Comal and San Marcos, have their origin, and why these throughout the whole year continue to break forth from under the rocks with the same force and temperature as well as with unvarying clearness.

Roemer, in his work on the chalk formations of Texas, says, that the chalk of the Highlands is proven by its organic remains to belong to a somewhat deeper geognostic horizon than that of the Hill-country, and is therefore older, although it lies higher. It is suddenly separated, steep and sharp, from the latter. He says, furthermore, it is possible that through a fault not apparent on the surface, the chalk of the Highlands near New Braunfels was forced back to the higher level, and he believes that such transposition and also the sudden and steep upheaval of the Highland, explains the remarkable change in the character of the rocks, and that the abrupt breaking forth of the sources of the Comal at the foot of the table-land has a close connection with it.

Northward and located somewhat higher there appears in a singular manner, almost wholly surrounded by the chalk formation of the Highlands, an entirely isolated tract of primitive mountain formation, and it is well to observe that this piece was lifted up through terrestrial forces after the chalk formations had already detached themselves. On this granite are found here and there isolated remains of chalk. Before the glacial era the entire mass was entirely covered with it, and it was almost completely destroyed during this long period, and I might therein discover not only a proof of its later upheaval, but also of the existence of the glacial era; so also other and not yet solved problems may here find a solution. Through the upheaval, the volcanic force extended also to the chalk surrounding the granite.

As already remarked, the chalk of the Highlands is much harder than that of the Hill-country; as a collective mass it resisted the upheaval, and was therefore lifted up at once with the granite: hence the steep declivity at the foot. By the upheaval considerable cavities would be formed in and under the

From the mouth of the Little Wichita into the Red river down to the Colorado river, where the Pecan bayou empties into the same, there lies, towards the west, a region about one hundred miles wide, that belongs to a much older mountain formation, the so-called coal or transition mountain.. In this is found in abundance the copper-schist or the Permian system, as also the Silurian. Shumard looked already upon this region as belonging to the coal-formation; and the organic remains which exist in the rocks speak most plainly; such are trilobites, fossil fishes of the families of Ganoids and sharks, and the imprints of the ferns with Equisetaceous and other plants. I have found also in this formation various Mollusca, chiefly *Brachiopoda* and *Lamellibranchiata*, wholly petrified in the iron-ore, called sphærosiderite. We find now and then, on the surface of this coal-formation, copper-ore, consisting mainly of malachite, which originally penetrated in veins through sandstone; it is often several inches thick. There are also found immense masses of iron-ore in very many different conditions, lying around loose on the slopes, in ravines, and everywhere; and especially those that appear most numerous, are the hematite and ironspar or sphærosiderite; and which, it seems, have been taken by some persons for copper; yet I have no doubt but that considerable copper and other ore deposits may still lie hidden in some deeper stratum. The different iron-ores contain, according to my analysis, twenty to seventy per cent. pure iron, and among them many spars, a little zinc, and traces of cadmium. If we compare these ores with those of other countries, it is apparent that they are among the best, and most easily reduced; they are the same ores out of which nearly nine-tenths of all the iron in England is produced.

From these geological and palæontological facts, we are permitted with all certainty to conclude that, although hitherto no positive data have existed, there must be throughout this whole division large, extensive, and genuine coal-beds. In the geological State museum at Austin can be seen large pieces of genuine stone-coal, but without any precise information as to the place of discovery.

Bismuth and antimony, it is claimed, have already also been found. Some time ago the newspapers gave information that a very rich silver mine had been discovered in Montague county; but it may well be doubted whether this news is correct, and it may

parts of the undulating Hill-country are found masses of petrified wood. As Roemer already correctly concluded, this belongs to the tertiary formation; and we can, therefore, by this means decide with certainty upon its presence there. The immense proportion of silex in this formation has petrified the wood, instead of carbonizing it.

On the bank-slopes of the Red river, near Shreveport, I found a layer one to two feet thick, which was half carbonized, and half petrified; and in the same stratum lay large logs of cypress in a half carbonized and half petrified state.

The large deposits of iron-ore in the tertiary formation of Eastern Texas may become of somewhat more importance than the coal in the Hill-country, but they by no means equal in value the ore-deposits of older origin. The iron is here found mainly as iron sandstone, and in many counties, as in Henderson, Anderson, etc., in such quantities that whole ranges of hills are formed of it; and the region presents many times, by their rocks and the ravines between, a quite romantic character; this is particularly the case with the so-called big rocks between Vanzandt and Henderson counties. The tertiary formation is also rich in salt deposits, and in many places the salt is successfully obtained from salt-springs. In the iron regions we encounter in some places very strong mineral springs, especially sulphur-springs. They hold in combination much carburetted hydrogen gas and sulphuret of iron; when they come to the surface, they liberate blackish gray and yellowish precipitates of sulphur and sulphuret of iron; but they do not come from any considerable depth like thermal springs, since they have nearly as low a temperature as the ordinary springs of the neighborhood. On the Neches river, as well as on the Sabine, I found larger deposits of a blackish-iron sandstone, which was quite loose and brittle; it holds iron mostly as sulphuret of iron. Owing to its slight coherency, the latter may, through several influences, be easily decomposed, and then on the one side give cause to the sulphur springs, and on the other to the sulphate of iron produced in that region. There are al
many beds of clay, which contain alum, or bittersalt, and
for this reason a strong taste to water; in partic
summer, there is seen in the bottom of tur
ration of the water, a white crust of thi
tance to mining in Texas are the

From the mouth of the Little Wichita into the Red river down to the Colorado river, where the Pecan bayou empties into the same, there lies, towards the west, a region about one hundred miles wide, that belongs to a much older mountain formation, the so-called coal or transition mountain.. In this is found in abundance the copper-schist or the Permian system, as also the Silurian. Shumard looked already upon this region as belonging to the coal-formation; and the organic remains which exist in the rocks speak most plainly; such are trilobites, fossil fishes of the families of Ganoids and sharks, and the imprints of the ferns with Equisetaceous and other plants. I have found also in this formation various Mollusca, chiefly *Brachiopoda* and *Lamellibranchiata*, wholly petrified in the iron-ore, called sphærosiderite. We find now and then, on the surface of this coal-formation, copper-ore, consisting mainly of malachite, which originally penetrated in veins through sandstone; it is often several inches thick. There are also found immense masses of iron-ore in very many different conditions, lying around loose on the slopes, in ravines, and everywhere; and especially those that appear most numerous, are the hematite and ironspar or sphærosiderite; and which, it seems, have been taken by some persons for copper; yet I have no doubt but that considerable copper and other ore deposits may still lie hidden in some deeper stratum. The different iron-ores contain, according to my analysis, twenty to seventy per cent. pure iron, and among them many spars, a little zinc, and traces of cadmium. If we compare these ores with those of other countries, it is apparent that they are among the best, and most easily reduced; they are the same ores out of which nearly nine-tenths of all the iron in England is produced.

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Bismuth and antimony, it is claimed, have already also been found. Some time ago the newspapers gave information that a very rich silver mine had been discovered in Montague county; but it may well be doubted whether this news is correct, and it may

have been published from interested motives. Gold, silver, lead, and molybdenum are, however, found in the previously mentioned primitive mountain formation of the Highlands, where in later times, in Llano county, a silver mine is said to have been put in operation. Westward of the coal-formation, particularly along Red river and in the Staked Plains, lie very large beds of gypsum; but the future must reveal to us how large treasures in metals lie in the still unknown regions of the west.

If we cast a retrospective look over the whole, we may assert with all certainty that Texas is approaching a very promising future. It is a country in which, on account of its fine and favorable position, not only all the plants of the temperate zone flourish, but also many of those of the tropics. The wine-culture, to which many a State owes its prosperity, is yet in the germ; but the results attained on a small scale hitherto, the great number of excellent wild grapes, as also the above-described constitution and combination of the soil,—are all speaking evidences of its adaptation to this noble fruit.

Texas has its own pine-forests in the east, which will be fully adequate to supply the whole State with lumber, and to fence in the fields; in the interior it has its own granary; and when once her own hand has wrought her own iron with her own coal, then will she supply not only her own wants, but many of those of the outer world.

Nowhere are there extensive swamps which makes residence unhealthy; the country has also no sections which suffer from excessive drouth. Winters have neither the northern cold, nor the summers the tropical heat; and pleasant breezes throughout the whole summer keep the air continually, not only in a refreshing condition, but contribute much to the salubrity of the country. Though we may not have to point out lofty, romantic mountains, still there are regions highly favored by nature, particularly those about San Antonio and New Braunfels, with their mighty springs, and their ever clear and refreshing water, that are especially noteworthy; which places, if they were lying on the sea, would justly be called the Texan Nice.

RECENT LITERATURE.

WEBSTER'S ANNELIDS OF THE VIRGINIAN COAST.—The worms of the coasts of North America have been sadly neglected by American naturalists. The annelid fauna of New England has been pretty thoroughly examined by Prof. A. E. Verrill, but with this exception, a few scattered descriptions by Stimpson and Leidy, and one or two others, comprise the whole literature of the subject. We have in Prof. H. E. Webster's Annelida Chætopoda of the Virginian coast, a valuable contribution to the literature of this group. In this pamphlet of seventy-two pages the author has enumerated fifty-nine species, representing forty-nine genera and twenty-three families, of which twenty-seven species and four genera (*Lepidametria*, *Aricida*, *Cabira* and *Phronia*) are new. The work is illustrated by eleven lithographic plates in which the author's individuality has been preserved.—*J. S. K.*

RUTLEY'S STUDY OF ROCKS.[1]—This little work gives a very fair idea of lithology, as it is taught upon the European continent at the present time. It is for the English reading student the best and almost only source from which he can obtain an idea of modern lithology outside of the very few schools in which the subject is taught; Von Cotta's "Rocks Classified and Described" having been antiquated long before it was published.

Mr. Rutley's book bears marked evidence that its author "crammed" for the occasion, and shows, if anything, less originality than his published papers. Yet in spite of this "cramming" he seems to be ignorant even of the lithological literature of his own isle. It is to be considered as the work of a tyro, and not that of a master, like many of our ordinary text-books. The work is recommended to the American student because it is the only thing of its kind to be had, and hence is necessary to any student who cannot read German.

Some of its defects are the lack of any mention of Des Cloizeaux's method of determining the feldspars, or of Pumpelly's ingenious modification of it; of Streng's method of distinguishing nephelite from apatite, or of the monoclinic character of the micas as shown by Tschermak.

On page 179 the remarkable statement is made that the feldspars are the "principal rounded crystals in vitreous rocks." His vitreous rocks are removed from the rocks of which they are the glassy modifications; his trachytes range from sixty to eighty per cent. of silica, including both the rhyolites and the greater portion of the andesites; cherzolite and dunite are removed from their natural position; in fact, his classification is about as much without form and void as he could well make it. In describing the microfelsitic base (167), he, as well as the Ger-

[1] *The Study of Rocks.* An Elementary Text book of Petrology. By FRANK RUTLEY. H. M. Geological Survey. New York, 1879. D. Appleton & Co.

mans, have utterly confounded, under one name, that which is a product of a cooling magma, and that which is a secondary alteration product in rocks On page 274 he states that "Petrology becomes the study of an endless cycle of changes from eruptive to sedimentary, and from sedimentary to eruptive rocks." A cycle of which the last half is neither sustained by field or microscopic research, nor by physics.

Such errors as picotite for pyrope (p. 141), chrysolite for chrysotile (p 271) disfigure the work. Speaking of tridymite, on page 152, he says, "It has also been mentioned as occurring in some Irish rock, but the author is unable either to recall the precise locality or to find the reference."

Had he looked on the upper part of the same page[1] on which his own paper on tachylyte is published, to which he refers so often, he would have found it, as well as in numerous other scientific journals published in England and on the continent.—*M. E. W.*

WRIGHT'S CONTRIBUTIONS TO AMERICAN HELMINTHOLOGY.[2]—In this paper of twenty-six pages and two plates, we have a valuable addition to our knowledge of the parasitic worms, which have been studied in this country by Leidy, Wyman, Verrill, Packard, Minot and Fitz. Thirteen species are enumerated, of which five are new. One new genus (*Sphyranura*) is proposed, while Leidy's genus *Clinostomum* is united with *Distomum*. In the descriptions of the species are included many anatomical facts; Minot's statement that the water vascular system and parenchyma spaces are connected in *Distomum* is confirmed. Some of the more interesting habitats recorded are *Polystomum oblongum* in the urinary bladder of the musk-turtle, *Sphyranura osleri* occurred in the mouth and gills of *Menobranchus lateralis*, *Tænia dispar* in *Rana halecina*. The round worm which was so prevalent in the shad last spring is referred by our author to *Ascaris adunca* Rud. The two plates which illustrate the article are well drawn and printed.—*J. S. K.*

SCIENTIFIC RESULTS OF THE CHESAPEAKE ZOOLOGICAL LABORATORY.[3]—The speedy publication and finished nature of the papers in this volume speaks well for the industry shown by those who worked at this hastily equipped laboratory, and shows that elaborately constructed laboratories and expensive museums are not, from new and improved biological methods, essential to the real advance of biology in its widest sense. It will be remem-

[1] Journal of the Royal Geological Society of Ireland. New series, Vol IV, Part 4, 1877.

[2] *Contributions to American Helminthology No. 1.* By R. RAMSAY WRIGHT. (Proc. Canadian Institute. New series, Vol. I, No. I.)

[3] *Johns Hopkins University, Baltimore, Md. Chesapeake Zoölogical Laboratory* Scientific Results of the Session of 1878. Organized and conducted by W. K BROOKS. (June 24 to Aug. 19, 1878) Baltimore, 1879. 8vo, pp. 170, 13 plates.

bered that Cuvier laid the foundations of his fame as a comparative anatomist at out-of-the-way spots on different points of the coast of France; Quatrefages made his most important researches on the coast in fishermen's houses, his tables of boards and his equipments most scanty. Better than elaborate and costly microscopes and laboratory apparatus is energy, industry and a mind well trained in the methods of research. All of these qualities are evinced in the publication before us, and is the result of workers trained in this country.

The contents, of what we hope will be the first of a series of similar biological contributions from the summer workshop of Johns Hopkins University, is an introductory giving an account of the foundation of the laboratory, to which the readers of this journal have already had their attention drawn. This is followed by papers on the Land Plants found at Fort Wool, by N. B. Webster; a list of animals found at Fort Wool, by P. R. Uhler; Development of Lingula, by W. K. Brooks; *Lucifer typus*, by Walter Faxon; Development of Gastropods, by W. K. Brooks; Development of Squilla, by W. K. Brooks. The paper on the early stages of Amphioxus, by H. J. Rice, has been delayed by the sickness of the author, and will be printed elsewhere at an early date.

Without disparagement to the other essays, that on Lingula will excite the most interest from the nature of the subject. The author, after a careful and fully illustrated study of the early stages of this shelled worm, as all must now regard it since Morse's discovery of its true relationship, concludes that the Brachiopoda are the most highly specialized representatives of the Polyzoön branch, the Rotifera, Polyzoa, and Veliger (a generalized form from which the different types of Mollusks are supposed to have diverged) having so separated at a very early period from a common vermian stem. "The three stems appear to be sufficiently closely related to each other, and sufficiently sharply distinguished from all other animals, to constitute by themselves one of the fundamental divisions of the animal kingdom, which might be called, on account of the conspicuous character of the trochal disc, the *Trochifera*."

Report of the Board of Commissioners of the Geological Surveys of Pennsylvania for 1878.—This document of four pages was printed for the use of the members of the Legislature, and is signed by Governor Hartranft, chairman of the Board. It conveys the information that twenty-four counties have been completely surveyed; thirty-one counties partially, and thirteen counties not surveyed. Thus a little less than half of the area of the State in counties has been surveyed, although actually rather more than half of the ground has been gone over. The most extensive continuous tract finished is that west of the Alleghenies and south of Crawford and Elk counties. The rapidity with which

... expressed in the statement that "we ... reports of the work done the ... believed to have been ... of Geological Surveys." The ... will be requisite for the ... an appropriation of $100,000 ... a very modest ... and is probably ... as economical ... the most ... that the ... elaborated ... the impor- ... from ... of the ... of ... several ... the State.

A few Last Words on Chara. By Alfred W. Bennett. (Ext. Jour. Bot. March, 1879.) 8vo, pp. 2. From the author.

Morphological notes on the Limbs of Amphiumidæ, as Indicating a Possible Synonymy of the supposed Genera. By John A. Ryder. (Proc. Acad. Nat. Sci.) Jan. 1879. 8vo, pp. 2. From the author.

Further Notes on the Mechanical Genesis of Tooth Forms. By John A. Ryder. (Proc. Acad. Nat. Sci.) 8vo, pp. 47-51. Philadelphia, 1879. From the author.

Notes on the Fishes of Beaufort Harbor, North Carolina. By David S. Jordan and Charles H. Gilbert. (Proc. U. S. Nat. Museum.) 8vo, pp. 365-388. From the author.

Della Balena di Taranto confrontata conquelle Della Nuova Zelanda econ Talune Fossili del Belgio e Della Toscana notizie del Prof. Comm. G. Capellini. 4to, pp. 34, pls. 3. Bologna, 1877. From the author.

Sui Cetoterii Bolognesi considerazioni del Prof. Comm. G. Capellini. 4to, pp. 34, Tav. 2. Bologna, 1875. From the author.

Della Pietra Leccese e di Alcuni Suoi Fossili Memoria del Prof. Comm. Giovanni Capellini. 4to, pp. 34, Tav. 3. Bologna, 1878. From the author.

Balenottere Fossili e Pachyacanthus dell'Italia Meridionale per G. Capellini. (From Reale Accad. del Lincei, Anno CCLXXIV [1876–67].) 4to, pp. 22, Tav. 3. Rome, 1877. From the author.

Sulla Balenottera di Mondini Rorqual de la Mer Adriatique memoria del Prof. Comm. G. Capellini. 4to, pp. 40, Tav. 4. Bologna, 1877. From the author.

Proceedings Acad. Nat. Sciences, Philadelphia, 1879. 8vo, pp. 25–56. From the Academy.

Valedictory address to the Graduating Class of Jefferson Medical College, at the 54th Annual Commencement, March 12, 1879. By J. Aitken Meigs. 8vo, pp. 20, Philadelphia. From the author.

Man. Vol. I, No. 8. 4to, pp. 8, New York. From the editor.

The Scientific Man. Vol. I, No. 13. 4to, pp. 97–104. New York, 1879. From the editor.

Proceedings of the Boston Society of Natural History. Vol. XX, Part I, May to November, 1878. 8vo, pp. 112, pl. 1. Boston, 1879. From the society.

Le Naturaliste, 1er Annee, No. 1, April, 1879, Paris. 4to, pp. 8. From the editor.

Bulletin of the American Meteorological Society. Constitution and By-laws, etc. 8vo, pp. 11. New York, 1879. From the society.

The Naturalists' Leisure Hour. Nos. 4 and 5, 1879. From the editor.

Congrès International des Américanistes Troisième session. Bruxelles du 23 an 26 Septembre, 1879. 8vo, pp. 12. From B. F. DeCosta.

A Century of Orthoptera. By Samuel H. Scudder. (From the Proc. of the Boston Society of Natural History, Vols. 12–20, 1879.) 8vo, pp. 83.

Studi sui Ragni Malesi e Papuani. Per T. Thorell II. Genova, 1878. 8vo, pp. 313.

Traces of an Early Race in Japan. By Edward S. Morse. (Reprinted from the Popular Science Monthly for January, 1879.) 8vo, pp. 10, illustrated.

Transactions of the Kansas Academy of Science, 1877 and 1878, Vol. VI. Topeka, Kansas, 1878. 8vo, pp. 92.

Pelagic Amphipoda. By Thomas H. Streets, M.D., U.S.N. (From the Proc. of the Academy of Natural Sciences of Philadelphia.) 8vo, pp. 15, 1 plate.

Scientific Results of the Exploration of Alaska. Article IV. Report on the Limpets and Chitons of the Alaskan and Arctic regions, with descriptions of genera and species believed to be new. By. W. H. Dall. (Bulletin U. S. National Museum, I.) 8vo, pp. 64, 5 plates and illustrations.

Phryganiden-Studien von Fritz und Hermann Müller. From Kosmos II, Jahrg. Heft II.) 8vo, pp. 11, illustrated.

Einstämmiger und Vielstämmiger Uhrsprung. Von Ernst Haeckel. (From Kosmos.) 8vo, pp. 17.

Ueber die Organization und Classification der Anthromedusen. Ueber die Organization und Classification der Leptomedusen. Von Ernst Haeckel. (Separat-Abdruck aus den Sitzungsberichten der Jenaischen Gesellschaft für Medicin und Naturwissenschaft. Jahrgs 1878–1879.) 8vo, pp. 7.

Notes on some Sections of Trilobites from the Trenton Limestone, and Descriptions of new species of Fossils. By C. D. Walcott. (Ext. from the 31st Report on the New York State Museum of Nat. Hist., Albany, March, 1879.) 8vo, pp. 13, 1 plate.

Descriptions of new species of Fossils from the Calciferous formation. By C. D. Walcott. (From the 32d Annual Report of the N. Y. State Museum of Nat. Hist., Albany, Jan., 1879.) 8vo, pp. 4.

Mélanges Orthoptérologiques. Par Henri de Saussure. VIme Fascicules. Gryllides 2me Partie. Genève 1878. 4to, pp. 328, 4 plates.

On the Anatomy of Ocherodrilus. By Gustaf Eisen. (Presented to the Royal Society of Upsala, the 11 Mai, 1878.) 4to, pp. 12, 2 plates.

The Early Types of Insects: or the Origin and Sequence of Insect Life in Palæozoic Times. By Samuel H. Scudder. (Memoirs of the Boston Society of Natural History, Vol. III, Part I, No. II, March 6, 1879.) 4to, pp. 9.

Les Arachnides de France. Par Eugène Simon. Tome quatrième. Contenant la famille des Drassidæ. Paris, 1878. 8vo, pp. 336, 5 plates.

Exotische Microlepidoptera. Beschrieben von Prof. P. C. Zeller I, II. St. Petersburg, 1877. 8vo, pp. 491, 6 plates.

Ueber die Goethe'schen Worte. "Leben ist die schönste Erfindung der Natur und der Tod ist ihr Kunstgriff viel Leben zu haben." Rede beim Antritt des Rectorats an der Königlichen Universität zu Kiel gehalten am 5 März, 1879. Von Dr. Karl Möbius. Kiel, 1879. 4to, pp. 14.

Samuel Butler's Gedanken über die Rolle der Gedächtniss-Uebung in der Entwickelungsgeschichte. Von Dr. Hermann Müller. Kosmos III, Jahrg., Heft I. 8vo, pp. 15.

Notice of Recent Additions to the Marine Fauna of the eastern coast of North America, No. 3. By A. E. Verrill. Brief contributious to zoölogy from the museum of Yale college, No. XL. (From the American Journal of Science and Arts, Vol. XVII, March, 1879.) No. 4, April, 1879. 8vo, pp. 14.

On the Complete Series of Superficial Geological Formations in North-eastern Iowa. By W. G. McGee. (From the Proc. of the Amer. Asso. for the Advancement of Science, Vol. XXVII, St. Louis meeting, August, 1878.) Salem, 1879. 8vo, pp. 34.

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GENERAL NOTES.

BOTANY.

DAVENPORT'S CATALOGUE OF THE DAVENPORT HERBARIUM.[1]—This is a catalogue of the Davenport Herbarium of North American Ferns of the Massachusetts. Horticultural Society, which contains specimens of every authentic species of the ferns at present known to inhabit North America, north of Mexico, consisting of thirty-two genera representing one hundred and forty-two species. The catalogue is a valuable addition to our botanical literature, and also timely, as an unusual degree of interest is now bestowed by collectors to ferns. If all would pay as much attention to the young stages and specific limits of

[1] *Catalogue of the Davenport Herbarium of North American Ferns north of Mexico.* Massachusetts Horticultural Society. Published by the author, Salem, Mass., 1879. 8vo, pp. 42. 50 cents. Address the author, George E. Davenport, Medford, Mass.

these beautiful plants as Mr. Davenport, and should this mode of study be extended to the higher plants, botanical science in this country would take a much higher stand than it now does, as collecting, cataloguing and the framing of local lists is but preliminary to the genuine study of the life-history, classification, genealogy and physiology of plants.

GOODALE'S CONCERNING A FEW COMMON PLANTS.—This is a small 16mo of 61 pages, issued as one of the Guides for Science Teaching, published by the Boston Society of Natural History. It is used by the teachers of the public schools of Boston, who to the number of five hundred attend the Teachers' School of Science of this popular society. The present little work is a most successful effort to induce teachers to qualify themselves for giving to their pupils a series of object lessons in elementary botany.

ALLEN'S CHARACEÆ AMERICANÆ.—This is the first part of what will prove a most useful monograph of our American Charas. It is published by the author, Dr. Timothy F. Allen, 10 E. 36th street, New York. A colored plate and a page of text form Part 1.

BOTANICAL NEWS.—The *Bulletin* of the Torrey Botanical Club for January and February contains a synopsis of discoveries and researches, in 1878, on fresh-water Algæ, by F. Wolle. In the March number Prof. Eaton describes a new Hawaiian fern, and Arthur Hollick contributes a few notes on the abnormal absence of color in plants.——In the *Botanical Gazette* for April, J. D. Smith records the occurrence of a tropical plant, *Ophioglossum palmatum*, on the west coast of Florida; Mr. C. F. Austin describes a number of new mosses. The number for May contains, among others, Notes on some rare plants, by W. Canby; On yellow snow, by T. C. Porter, and Descriptions of some new mosses, by C. F. Austin.——Notes on Californian fungi, by M. C. Cooke, appear in *Grevillea* for March.——Trimen's *Journal of Botany* for April, contains an article on the sources of Chinese matting, by H. F. Hance.——The relation of forests to rainfall is discussed by Prof. J. E. Todd in the Iowa Horticultural Report for 1878. He believes with others that the growth of trees may increase the rainfall, and does not fear that the future forests of Iowa will ever seriously suffer from drouth.——We have received from Dr. Hermann Müller a pamphlet giving farther observations on the fertilization of flowers by insects. (Extracted from the Trans. of the Natural History Society of Prussian Rheinlands and Westphalia, xxxv, Bd. v.)

Ueber die Organization und Classification der An- ization und Classification der Leptomedusen. V- druck aus den Sitzungsberichten der Jenaischen G- urwissenschaft. Jahrgs 1878-1879.) 8vo, pp. 7.

Notes on some Sections of Trilobites from the tions of new species of Fossils. By C. D. Wal- the New York State Museum of Nat. Hist., Al- 1 plate.

Descriptions of new species of Fossils from th- Walcott. (From the 32d Annual Report of the Albany, Jan., 1879.) 8vo, pp. 4.

Mélanges Orthoptérologiques. Par Henri d- lides 2me Partie. Genève 1878. 4to, pp. 328.

On the Anatomy of Ocherodrilus. By Gu- Society of Upsala, the 11 Mai, 1878.) 4to, p-

The Early Types of Insects: or the Origin zoic Times. By Samuel H. Scudder. (M- History, Vol. III, Part I, No. II, March 6, 18-

Les Arachnides de France. Par Eugène famille des Drassidæ. Paris, 1878. 8vo, -

Exotische Microlepidoptera. Beschri- Petersburg, 1877. 8vo, pp. 491, 6 plates.

Ueber die Goethe'schen Worte. "Le- und der Tod ist ihr Kunstgriff viel Leben- torats an der Königlichen Universität zu - Karl Möbius. Kiel, 1879. 4to, pp. 14.

Samuel Butler's Gedanken über die K- elungsgeschichte. Von Dr. Hermann pp. 15.

Notice of Recent Additions to the America, No. 3. By A. E. Verrill. - of Yale college, No. XI. (From the XVII, March, 1879.) No. 4, April, 1-

On the Complete Series of Supe- Iowa. By W. G. McGee. (From ment of Science, Vol. XXVII, St. L- pp. 34.

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DAVENPORT'S CATALO- This is a catalogue of American Ferns of th- which contains specime- at present known to - consisting of thirty-t- forty-two species. T- botanical literature, - interest is now best- pay as much attenti-

[1] *Catalogue of the Da- Mexico.* Massachusetts Mass., 1879. 8- Medford, Mass.

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...work already done in the direction of ...complete knowledge of the anatomy of ...ore is known of the modifications due to ...umber of species names will be sensibly ... will lie almost wholly in the line of their ...nd embryology. Not one organ, but all, must ...ation, then the external expression of these ... clearly comprehended.—*P. Ellsworth Call.*

...GRESS OF THE IMPORTED CABBAGE-WORM.— ...report, in treating of this insect, I remarked, ...n to fear that it may some day get a foot- ...after showing that it was then confined to ...rts of Canada and New England, and had not ...s York. It has been making further progress ...son since. The past year it has done consid- ...ar west as Chicago, and I have also received ...at it was observed around St. Louis. I have ...s in the report referred to, for believing that it ...more disastrous to the cabbage-fields around St. ...southern cabbage-worm (*Pieris protodice*), which ...n with us, and has done, at times, considerable ... refer those who wish to be prepared with a full ...the habits of this species, to that same report.

... few liquids will prove more effectual than hot- ...sly applied, though one pound of whale-oil soap ...about six gallons of water, or even strong tar-water ...d to advantage. The application should be made ... during the year, as it will be most effectual when ...are young.

...ntive measures, the worms may be induced to trans- ...r flat pieces of board laid upon any object that will ...n about an inch from the surface of the ground. These ...should be examined every week, and the transforming ...the chrysalids destroyed. The butterflies may also be ...d by hand nets and prevented from laying their eggs.— ...V. Riley before the Mo. State Hort. Soc., Jan. 1879.*

...THENOGENESIS IN THE HONEY-BEE.—In the article in the AMERICAN NATURALIST, p. 261, copied from the *Comptes* ..., we have illustrated the danger of hasty generalization. ...iter of the article suggests that the "Dzierzon Theory" ...a insufficient observation. This is far from the truth. The ...observation not only by German but also by many Ameri- ...arists, not only of one queen and her progeny, as was the

ZOÖLOGY.[1]

SYNONYMOUS UNIOS.—The following synonomy is based upon series of shells received from Prof. Witter, Muscatine, Iowa, and Dr. J. Schneck, Mt. Carmel, Ill., purporting to be *Unio nasutus*. That both series represented the same species was beyond doubt, but that it was *U. nasutus* was as plainly to be doubted. From obvious resemblances they were compared with *U. nashvillensis* Lea, and *U. mississippiensis* Con., and the several series were found to be identical, and it was further established that none of them were *U. nasutus*. The comparison was based upon the position and form of the cicatrices, the size, position and angulation of the teeth, crenulation of the lateral teeth, color of the nacre and of the epidermis (after treatment with oxalic acid to remove ferruginous matter). Then came the query, "which is which?" The western collectors all call the shell *U. nasutus*, which is evidently incorrect. *Nasutus* is a flat, slender shell, and, like *U. complanatus*, belongs to the Atlantic slope, though both Mr. Lea and Mr. Say assert that "the species inhabits the western waters."

Mr. Lea in his Synopsis of the Unionidæ, p. 60 (note on *U. iris*), himself points out a possible solution. He says, "As the *U. nasutus* inhabits the western waters, a variety of that species may have been described by him (Mr. Say) for *subrostratus*." Here a thought suggested itself that both Mr. Lea and Mr. Conrad had described a *new species*, varieties of Say's older *subrostratus*. In my perplexity the shells were submitted to my friend Dr. Lewis, of Mohawk, N. Y., for further study and correction. We compared them with Say's description of *subrostratus*, with typical series of the other species mentioned above, and they were pronounced by him to be identical. Subsequent to this, after my arrival again East, Dr. Lewis writes (May 17, 1878), "I have got to the bottom of the synonomy of the shells you had from Dr. Schneck. He and many of the western collectors call the shell *wrongly U. nasutus* Say. It is *U. subrostratus* Say. Add to it the synonomy of *U. nashvillensis* Lea, and of *U. mississippiensis* Con., and you have it all complete." He further says, "Mr. Lea makes *subrostratus* a synonomy of *iris*. Lea followed Say, who was in error as to what was *iris*, which it is clear he had not seen." Say's *subrostratus*, therefore, stands as a good species, and, because of its priority of publication (1831), we must write as its synonyms *U. nashvillensis* Lea, and *U. mississippiensis* Con.

There is a marked difference in the outline of the shell in the sexes of all these species. Nor is this difference without marked prominence in the same sex, which, as Gegenbauer has shown (Comp. Ana ...), must be regarded as caused by the relative positions of ... ous organs. Every one, who has dissected any great ... Unios, knows full well the differences in rela-

[1] The depart... thology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S...

tive position of the various organs. It is more than probable that these differences result in a modification of function, and of so marked a nature that the external characters may be sensibly changed.

Notwithstanding the work already done in the direction of synonomy, when a more complete knowledge of the anatomy of Unio is attained, and more is known of the modifications due to range and station, the number of species names will be sensibly diminished. This work will lie almost wholly in the line of their comparative anatomy and embryology. Not one organ, but all, must receive their due attention, then the external expression of these organs will be far more clearly comprehended.—*P. Ellsworth Call.*

THE WESTWARD PROGRESS OF THE IMPORTED CABBAGE-WORM.—In 1869, in my second report, in treating of this insect, I remarked, "There is every reason to fear that it may some day get a foothold in our midst," after showing that it was then confined to certain restricted parts of Canada and New England, and had not spread west of New York. It has been making further progress westward every season since. The past year it has done considerable damage as far west as Chicago, and I have also received good testimony that it was observed around St. Louis. I have given my reasons, in the report referred to, for believing that it will prove much more disastrous to the cabbage-fields around St. Louis than the Southern cabbage-worm (*Pieris protodice*), which has always been with us, and has done, at times, considerable damage, and I refer those who wish to be prepared with a full knowledge of the habits of this species, to that same report.

As remedies, few liquids will prove more effectual than hot-water, judiciously applied, though one pound of whale-oil soap dissolved in about six gallons of water, or even strong tar-water may be used to advantage. The application should be made several times during the year, as it will be most effectual when the worms are young.

As preventive measures, the worms may be induced to transform under flat pieces of board laid upon any object that will raise them about an inch from the surface of the ground. These boards should be examined every week, and the transforming larvæ or the chrysalids destroyed. The butterflies may also be captured by hand-nets and prevented from laying their eggs.—*Prof. C. V. Riley before the Mo. State Hort. Soc., Jan. 1879.*

PARTHENOGENESIS IN THE HONEY-BEE.—In the article in the April AMERICAN NATURALIST, p. 261, copied from the *Comptes Rendus*, we have illustrated the danger of hasty generalization. The writer of the article suggests that the "Dzierzon Theory" rests on insufficient observation. This is far from the truth. The closest observation not only by German but also by many American apiarists, not only of one queen and her progeny, as was the

case with the author of the article, but of hundreds, has placed Dzierzon's theory on a certain basis. The writer says, referring to his single hive, " from this it is evident that the drone eggs, like those of the females, receive the contact of the semen deposited by the male in the female organs."

It is well known that virgin queens will lay eggs that will produce exclusively male bees. I have seen several such cases. I have known queens reared late in autumn to pass the winter as virgins and ever after to produce only male bees. Deformity of the queen, or clipping her wing while yet a virgin, so that she may be unable to take the " marriage flight," precludes mating, and as surely makes a " drone laying queen." Old queens with shriveled spermathecas are often drone layers.

How did the writer know his queen in question was not a hybrid? He could not know. Many hybrid queens are to all appearance perfectly pure. Again, how did the writer know that the drones were hybrids or blacks? Frequently the drones of our queens imported right from Italy, like the queens, are almost as dark as the drones of the German race, yet the three banded workers show the queen to be pure. One case alone, however striking, should not be regarded as fatal to so well established a theory. The case given, so far as given, is no evidence against parthenogenesis of the drone bees.—*A. J. Cook.*

Perez' paper in the *Annales des Sciences Naturelles* for April, 1878 (only just received), is followed by one published in June, 1878, by A. Sanson, who thinks that Perez goes too far in qualifying the insufficiency of the observations of Dzierzon, and who has not given the most exact interpretation to his own (Perez) observations. The view that the honey bee is parthenogenetic is confirmed by the fact that a number of other insects are produced from unfertilized eggs; besides Mr. Sanson believes that the hybrids produced in Perez' hive were the result of the action of the law governing the reproduction of hybrids of all kinds, in the different branches of the animal and vegetable kingdoms, and which recognizes ancestral influences, atavism, the reversion to characters not existing in the immediate parents. In truth, the queen manifested the law of heredity which is observed in all hybrids. She had the external characters of the pure Italian, at least those of color; coupling with a brown male the eggs it laid gave birth to workers of varied characters such as exist in all hybrids. Sanson also criticises adversely the views of Gerard based on the observations of Perez. Gerard admits th[illegible] the hive examined by Perez, there were workers which [illegible] eggs. Sanson doubts whether careful observations woul[illegible] the co-existence in this hive of [illegible] queen [illegible] —*Editors Naturalist.*

THE ANATOMY OF THE [illegible]
received some interestir[illegible]

tions of Drs. Chapman and Parker of Philadelphia. Dr. Chapman dissected a young gorilla which belongs to the Museum of the Academy of Natural Sciences, and a young chimpanzee which had been living in the Zoölogical Gardens of that city. The observations on the gorilla relate chiefly to the muscular and circulatory systems. Dr. Chapman found in the anterior limb a distinct extensor primi internodii pollicis muscle, but no trace of flexor longus pollicis. He also observed an artery not previously described, which is given off from the femoral from the middle of its course, and accompanies the long saphenous nerve and vein to the inner aspect of the foot. While admitting that this vessel may be anomalous, its size and importance, and presence on both sides, lead Dr. Chapman to propose for it the name of the long saphenous artery. The same writer, in his observations on the brain of the chimpanzee, finds that the posterior lobe of the cerebral hemisphere does not cover the cerebellum, in accordance with the view of Professor Owen. Dr. Parker's investigations lead him on the other hand to the opinion that the posterior lobes do cover the cerebellum as stated by Prof. Huxley.

On a Difference between the Rana esculenta and other species of Batrachians.—In July, 1877, while engaged in a series of experiments on the effect of dry and moist heat on animals previously subjected to various operations, I found that not one of my frogs responded to dry heat applied to any portion of the skin. The application was made with a red or white-hot metal rod. This was so surprising a result that it seemed very probable that it depended on some peculiarity of the Batrachians experimented upon. The observations were made on the *Rana clamitans* and its ally, *R. pipiens*, and were continued unconnectedly until June, 1878, up to which time I had not found a frog in whom the heated rod acted as a sensory irritant. Burning the sensory nerves failed to produce any movements, the motor nerves however were excitable for this method of irritation.

. After my return to Geneva, in July, these experiments were continued on the *Rana esculenta* with the same result. In August some *Rana temporaria* were obtained from Berne. These were found to be very sensitive to dry heat. This sensitiveness remained when the heated rod was applied underneath the skin. The nerves also were very readily excited by dry heat. At the same time the *Rana esculenta* from the same locality were so insensible to dry-heat that they would allow themselves, though free to move, to be burned to a crisp in the reducing flame. The same experiment could not be made with a *Rana temporaria*, as these animals jumped away as soon as the heat became uncom- These observations were found to hold good of animals well as of those with brain and medulla oblongata; of m the skin had been dried as well as in those in as moist; in females as well as in males.

Hyla viridis, *Bombinator igneus* and *Bufo calamita* were all sensitive to dry-heat applied to the skin or sensory nerves.

The frogs examined in September gave the same result as those examined previously. In the beginning of October, in several *R. temporaria* the skin was found to be no longer sensitive to dry heat, the sensory nerves, however, remained sensitive to this irritant. The *Rana esculenta* were as in the previous month.

The first week of November the temperature was almost continually below the freezing point. On examining the sensitiveness for heat, I found that the *Rana esculenta* had become quite sensitive to impressions of heat. The frogs of the *temporaria* species had at the same time their sensibility for this irritant greatly reduced. At this time I received, through the kindness of my friend Mr. Richard Lomer, who assisted me in quite a number of my experiments, a number of frogs from Heidelberg. At Heidelberg Mr. Lomer found that the skin of the *Rana esculenta* could be irritated by dry heat, while that of the *Rana temporaria* could not.

Immediately on their arrival these frogs were examined, and both varieties were found to be sensible to heat, though the frogs of the *esculenta* species responded much slower than the *temporaria*. At the moment of writing (Nov. 23d) almost all the *Rana esculenta* are insensible to heat. They become sensitive to this agent when their brain has previously been destroyed. Though this is true of the terminations of the sensory nerves in the skin, it is not true of the nerve trunks, these always remaining insensible.

All the varieties of Batrachians that I have thus far examined, appear to be sensible to moist heat from 35° C. upwards.

As it is impossible for me to continue these observations on but a very limited number of Batrachians, it would afford me great pleasure were any of the readers of the AMERICAN NATURALIST, many of whom have such excellent opportunities for such researches, inclined to assist me in these investigations. It would be of great interest to know in all these examinations the locality, the time of the year and the temperature of the surrounding atmosphere in which the experiments are made.—*B. F. Lautenbach, Geneva, Switzerland, Nov.* 23, 1878.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The third number of the *American Antiquarian* contains the following papers: Native American Architecture, by E. A. Barber; The phonetic elements in American languages, by Dr. J. A. Farquharson; The inscribed stone at Grave Creek mound, by Prof. M. C. Read; Traces of Bible facts in the traditions of all nations, by Rev. Stephen D. Peet; Mythological text in the Klammath language, with comments by A.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

S. Gatschet. Nearly one-half of the number is occupied with correspondence and notes that are quite as valuable as the more extended articles, if the authors of the latter will pardon us. It should be well understood that very few of our special periodicals are paying expenses. In order to keep them alive, therefore, the friends of that branch of knowledge must make sacrifices to sustain them. So let it be with the *Antiquarian.*

We have received from the author, Mr. John Campbell, M. A., Montreal, a pamphlet entitled, "The affiliation of the Algonquin languages." The paper is supplemented with a linguistic chart showing the supposed affiliation of the Algonquin tongues with the Malayo-polyenesian, Ural-altaic, Asiatic-hyperborean and Peninsular languages.

The volume containing the report of the forty-fourth session of the Congrès Archeologique de France, held at Senlis, in 1877, is devoted principally to that branch of archæology which is outside of our area. There are a few interesting illustrated papers on the prehistoric archæology of France which will pay the perusal.

The first and the second fasciculus of the *Bulletins* of the Société d'Anthropologie de Paris, for the year 1878, contain very valuable matter of general import.

On page 13 Paul Bert speaks of barometric pressure as a factor in civilization, on the occasion of presenting his book entitled: La Pression Barometrique, recherches de physiologie expérimentale.

On page 56 is a communication, by M. Coudereau, upon the precocity of development in relation to nourishment. At the close of the article is a series of questions which M. Condereau proposes to be put in the hands of travelers.

The article by Dr. P. Topinard on the insertion of the hair of negroes in tufts is as interesting as it is original. We make a few extracts from it. "The fundamental division of the human races into two branches rests, by common consent, upon the characteristics of the hair; of this classification Bory de Saint-Vincent is the author. The first branch contains the races with straight hair, the second, the races with woolly hair."

There is a subdivision of the second branch made by M. Haeckel, and generally accepted. It depends upon the manner in which the woolly hair is distributed over the surface of the body and more particularly of the head. In one case their insertion is continuous, like the straws in a field of wheat. In the other it occurs in bouquets, or isolated tufts, having between them free spaces where the skin is glabrous. M. Haeckel calls the former *eriocomi*, the latter *lophocomi.* The origin of this character, of such great importance, if it is true, goes back to Barrow, at the commencement of this century. The Hottentots, said he, have hair of a singular nature; it does not cover the head totally,

but is in little tufts a small distance from one another. When they cut it short it resembles a shoe-brush, with this difference that the tufts are twisted into little knots the size of a pea. The same assertion is made by travelers concerning other negro races.

But as far as my observation goes, the character according to which M. Haeckel and others cut into two subdivisions, the grand branch of negroes does not exist at all. Among all the negroes the hair grows uniformly upon the surface of the head and of the body. Among all there are tufts. But these tufts are not indicated upon the skin. The hair of the negro varies in aspect more than people ordinarily imagine, as Hombron was one of the first to remark. It is presented under three principal forms, between which there are all sorts of intermediary groups.

The first is the typical form, which characterizes most generally the inferior negro races, to which the Hottentots belong; it is the arrangement of the hair called "grains of pepper." This appearance is produced by the shortness, the turns of the spirals being very close and giving rise to very narrow coils or rings, perhaps 2–4 millimetres; by the hairs being very numerous; and finally, by the total abandonment of the hair to itself.

The second is in the form of locks twisted in curls, small or large, from 6–8 millimetres in diameter; locks which one might speak of as *tufts*, but much elongated, at times reaching 25 centimetres (Fritsch). Evidently Barrow meant this, when speaking of certain Hottentots, "when they let their hair grow, it falls on the neck in twisted tassels, somewhat like fringe," this form and the preceding Bonwick observed among the Tasmanians.

The third form is presented in the shape of a cushion or compact mat, more or less large, elastic, returning to its original curl when compressed with the hand. It is a distribution of the hair in which the spirals are mixed, confounded without the least appearance of order. It is encountered most frequently in the negro races with long hairs and at the same time with less savage races who take some pains with their toilet. It is in this form that we meet these bizarre coiffures, described by travelers among the Caffres, Mpongwes, Somalis, Papuans, etc.

These same hairs, sufficiently abandoned to themselves, return to the preceding form with more or less facility.

Finally, taking into account my own experience, and after attentively reading the travels describing the Hottentots, Papuans, and other negroes, I conclude that the division of the woolly-haired races by M. Haeckel into *lophocomi* and *eriocomi* is without foundation. On page 94 will be found the report of a committee consisting of MM. Bordier, Topinard and Bertillon, to examine a negro in one of the hospitals.

GEOLOGY AND PALÆONTOLOGY.

THE TERTIARY ERUPTIVE ROCKS.—The trachytic formation is a most interesting one, but also very complicated. Hungary may be considered as the cradle of our notions respecting it since the time of Beudant. Richthofen imported the classification to California as it was established about eighteen years ago, based chiefly on habitus-characters. The geologists of the Vienna school have continued the study of it, and about some twelve years ago they published the geological map of Hungary too, also showing the considerable progress made since the departure of Richthofen.

The geologists of the 40th parallel have accepted as a base the classification of Richthofen, but with some alterations suggested by Zirkel; and that is about the classification adopted by Endlich and the other geologists of Prof. Hayden's staff, with the only difference that they have abandoned the propylite.

Owing to the method employed, the petrographical part, as regards the feldspars, the true base of classification is incomplete: firstly, the plagioklastic feldspars are not distinguished specially; secondly, every glassy feldspar has been taken for (potash) sanidine, which is not the case.

In Hungary and some adjacent countries, the trachytes have been the object of my detailed studies nearly since Richthofen's time. I commenced as field-geologist, and have continued as such, but making the aid of petrography serviceable to my field-work. I came to the conviction that those two branches of investigation are contributing to the appreciation of the true nature of the eruptive rocks in a surprising manner; the mineralogical association also agreeing with the chronology of the eruptive rocks belonging to the same cyclus of eruption.

If you have no objection I will give a sketch of my classification of the Tertiary eruptive rocks:

1. *Basalt, Leucitite.*

2. *Augite—Anorthite, Trachyte* (no quartz, no biotite). This in its normal state is the porphyre trachytique of Beudant, the andesite of Buch, the augite of German geologists; in its modified state it can take up the habitus of greenstone (augite propylite), and in other circumstances it may become basaitic, but it is never rhyolitic.

3. *Biotite—Amphibole-Labradorite Trachyte.* Without or with quartz, without or with augite.

In its normal state it may belong to the "echter trachyt" of the Austrian geologist, or to the amphibole-andesite. It can take up the greenstone (amphibole-propylite), or the basaltic, and very imperfectly the rhyolitic modification.

In some Hungarian trachytes of this type the garnet occurs in the mineralogical association, apparently replacing the lime-feld-

spar. Of two labradorite-trachytes of the same country, the one being with, the other without garnet, the latter is younger.

4. *Biotite-Amphibole Andesin* (*oligoclase*) *Trachyte.* Without or with quartz, without or with augite.

In its normal state it may belong partly to the "echter trachyt," or to the amphibole-andesite; in its modified state it passes in some cases to greenstone (propylite), rarely to basalt (oligoclase basalt), but by taking up a pearlitic and sphærulitic structure, often to rhyolite.

5. *Biotite Orthoclase* (plagioclase) *Trachyte.* Without or with quartz; without or with amphibole.

In a normal state it may have the appearance of syenite or granite; in its modifications the rhyolitic in the highest degree (pearlite, pitchstone, obsidian) is often met with.

In Hungary volcanic activity also ended in an outburst of basalt, and it is convenient to give to it a special color on the map, though its formation may be regarded as an episode accompanying nearly every one of the four periods, so that not only the augite-anorthite trachyte has been followed by a basaltic outflow, but after the close of the biotite labr. trachyte eruption, an outburst of basalt took place also, in which some of the associated minerals of this trachytic type may be recognized; and so there may have been basaltic eruptions at the end of the biotite-andesite, and rarely of the orthoklase trachyte too; but such distinctions not being observable in the field, the custom of uniting them in the geological map is to be maintained.

The leucitite is closely allied with the orthoclase-trachyte; in Italy it is always to be found in the region of orthoclase-trachyte. It is a kind of basic modification of the biotite orth. olig. trachyte. It can be colored as basalt with some additional mark.

The greenstone modification has been produced originally by solfataric, and subsequently by metamorphic and still existing action. The rhyolite is the modification of an older acid-trachyte, in most cases of the biotite orth. olig. trachyte (with or without quartz), produced by submarine activity of a newer basic trachyte breaking up under it. The orthoclase being more easily fusible than the labradorite or the (nearly) infusible anorthite, and having the property of forming very fusible hydrosilicates much more easily than all the plagioclastic feldspars, is converted into the glassy hydrated compounds (rhyolites). Every rhyolite indicates the contact with a younger trachyte of a more basic character, in most cases with the augite-trachyte. The rhyolites may be of a different age, because every one of the three younger trachytic periods can have produced this modification; but the most characteristic pearlites and obsidians have, of course, been formed in the newest period of the trachytic eruption.

In such regions, where after the outflow of biotite orth. trachyte no new eruptions ensued, no rhyolite is to be found; the biotite

orth. trachyte occurs in its normal porphyritic, syenitic or granitic state.

On the map the greenstone-trachyte (propylite) and the rhyolite, as important habitus-characters, are to be signalized by a secondary mark on the respective trachytes.

The chronological order has been established by means of the sedimentary formations formed wholly or partly by trachytic ejections, aided by the breaking of younger trachytic masses through older ones, in which case in the region of contact the minerals of two different types may be found mingled.

The trachytic types as enumerated according to their order of basicity, exhibit at the same time also the chronological series of the eruptions. The limits of time for the trachytic formation in Hungary are the following:

1. The eruption of the augite-anorthite trachyte took place in the Upper Miocene (Sarmatische Stufe).
2. The biotite-amphibole labradorite trachyte corresponds to the Middle Miocene (Mediterranean Stufe).
3. The biotite-andesite (oligoclase) trachyte appeared during the Lower Miocene.
4. The biotite orthoclase trachyte is the product of the beginning of the trachytic cyclus of eruption during the Upper Eocene.

For the field-geologist, who visits a country for the first time, such a detailed classification is of course impossible; he must be contented with a general one, but one which should still be in accordance with the former. He may arrive at that by means of some microscopical minerals, some habitus properties, aided in many cases even by panoramic characters of the single trachytic types, all that being taken into consideration not only on the eruptive rocks themselves, but also on the sediments containing trachytic fragments.

Two classes are easily distinguished: the augite-trachyte and the biotite-amphibole trachyte; the former is the younger, the latter the older. Since the time of Beudant, the "trachyte micassé amphibolique" has maintained itself and is well characterized by the microscopical minerals mentioned.

With the aid of rhyolites three classes can be established: the oldest trachyte being the biotite orthoclase (quartz) trachyte. The presence of pearlite and other glassy modifications involves two distinct types of trachytes; the rhyolite is the transformation of the older acid type by a younger one of a more basic feldspar, which remains in some cases concealed under the cover of the rhyolite, while in other instances it breaks through it. On the line of contact the highest degree of rhyolithism is perceptible, while with the increasing distance the normal state is more and more preserved.

The general features of these three classes are so prominent, that once acquainted with them, they are to be discovered every-

where, notwithstanding the varieties, which are indeed numberless, but which do not exercise any influence on the fixed characters needed for the above classification.

The order of eruptions is the same not only in Hungary, but down southward as far as to the region of the active volcanoes of Italy and Greece. Vélain has found it so on the isle of Reunion; Professor Heddle Forster informs me, that in the Tertiary volcanos of the Hebrides the first out-flow is a granitic rock with orthoclase, the second an augitic rock with labradorite, the third amygdaloids and basalt with labradorite. The admirable work just issued, "Santorin et ses eruptions," by Fouqué, confirms this order also for that volcanic island; the amphibol-labradorite, more acid rocks are older, the augite labradorite-anorthite more basic rocks younger.

There is no doubt, that the trachytes of the Rocky Mountains will follow the same law; but as regards the limits of time, the cyclus of eruption may exhibit a difference in the relative age. It could have begun sooner in one country, and later in another, corresponding to distinct volcanic basins, formed in different times. As regards the cyclus of trachytic eruptions in Hungary, and in the western part of the United States, there are many indications that lead me to adopt the opinion that our cyclus antedates yours.

In order to enable us to pursue more extensive comparative studies, descriptions are not sufficient; the objects must be seen too, at least samples of rocks should be at our disposal. You are very generous and liberal, whenever the interests of science are in question; may I ask you to let me have some of your duplicates of typical rocks.

We have in Hungary a beautiful series of pliocene, miocene and eocene rocks, and so the age of eruptions can be well settled. Your series seems far from being so clear, and so complete, the connection between the trachytic series and the sedimentary formations is consequently not so evident.

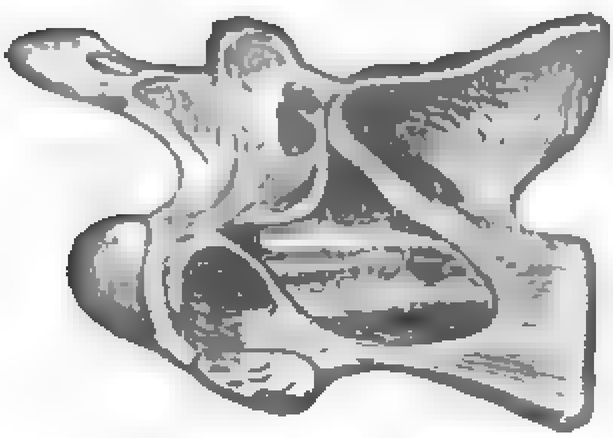
I should like very much to have samples of your marine clays and sands of miocene and eocene also. Professor Hantken, the director of the Hungarian Geological Institut at Budapest, is the specialist for the nummulites, orbitoides and Foraminifera generally. It would be very good for science, if he could have an opportunity to make comparative investigations; while on the other hand, I could ascertain whether traces of volcanic sand are contained in them.—*Dr. Joseph Szabó, Prof. of Min. and Geology in the University of Budapest.* (*Extract from a letter to Prof. Hayden.*)

NEW JURASSIC DINOSAURIA.—A second species of *Camarasaurus*, from the Jurassic of Colorado, is indicated by three cervical vertebræ, and probably by other remains in my collection. The dimensions of these specimens are a little less than that of the largest neck vertebræ of the *Camarasaurus supremus*, but the average length is not very different. The proportions are charac-

teristic. The centrum is little depressed, the vertical and transverse diameters of the cup being nearly equal. The form is thus much more slender than in the *C. supremus*, indicating a neck somewhat like that of the *Trionyches* or *Chelodinæ*.

The parapophyses descend backwards and downwards from the edge of the anterior ball; they are much shorter than the diapophyses, which are decurved. The side of the centrum and coössified base of the neural arch are excavated by a large fossa, which is somewhat subdivided. A smaller fossa is in front of it above the parapophysis. Still another divides the posterior base of the neurapophysis, on each side of the neural arch. The posterior

1.



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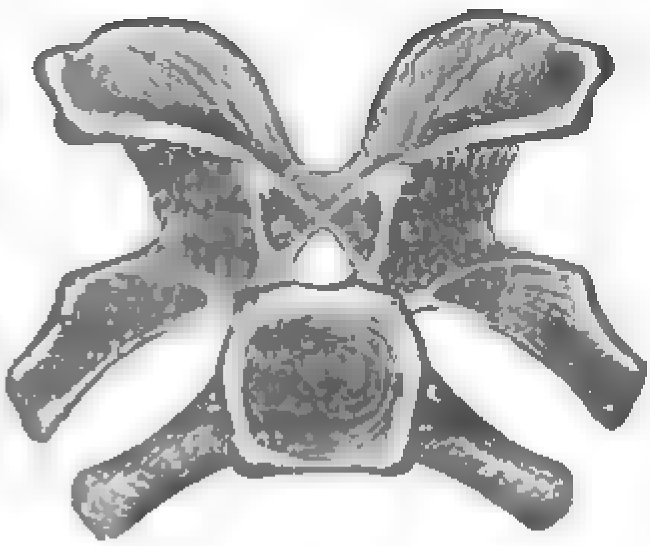

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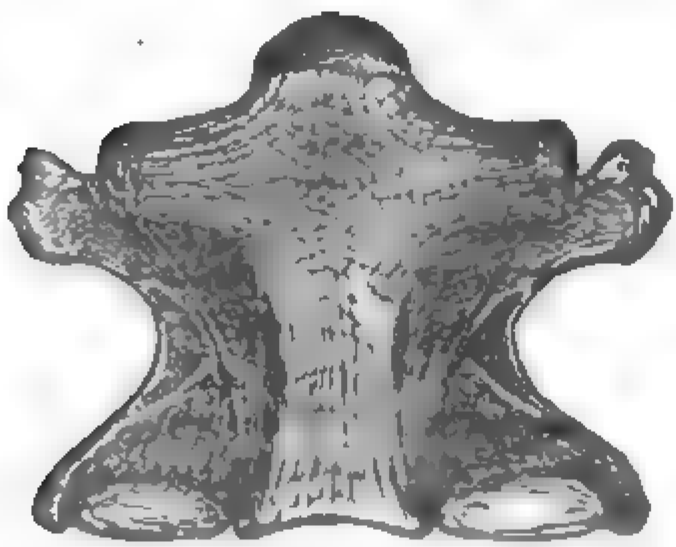

EXPLANATION OF CUTS.

Cervical vertebra of *Camarasaurus leptodirus*, one tenth natural size. 1, right side; 2, posterior end; 3, inferior surface. Fig. 1 is taken from one vertebra; figs. 2 and 3 from another.

zygapophyses support a strong superior crest, and their superior edges converge to meet at an angle without forming a neural spine at or posterior to the middle of the length of the neural arch, as is the case in *Epanterias amplexus*. The external bases of the zygapophyses are excavated deeply. Length of centrum m. .430; vertical diameter of cup, .140; transverse do., .160;

expanse of diapophysis, .380; of posterior zygapophyses, .450; elevation of do., .250; elevation of do. with crest, .360. The species is named *Camarasaurus leptodirus*.

Bones of an allied species recently received from Colorado, represent a most gigantic animal. The transverse diameter of the cervical vertebra is fifty-six inches, and that of the distal end of the femur, twenty-one inches.

A species of the carnivorous Dinosaurian genus *Hypsirhophus* has lately been received from another locality, which adds considerably to our knowledge of it. Vertebræ, limb bones and teeth found together, confirm the correctness of my supposition as to the true affinities of the genus.[1] The animal obtained is about the size of the *Hadrosaurus foulkei*. The dorsal vertebræ display the zygapophysial mass greatly elevated on a stem which has a quadrate section, with anterior and posterior grooves. There is no hyposphenal articulation. The diapophyses are wider than deep, are directed obliquely upwards from the superior margins of the zygapophyses, and have a prominent anterior superior border; the neural spine is short and compressed. The centrum is amphiplatyan and moderately compressed at the middle. The caudal vertebræ are not very elongate, and have a compressed hexagonal section. The chevron facets are on produced bases. Many of the teeth are less compressed than usual with Megalosauroid species, and have two denticulate edges. Length of dorsal centrum m. .100; vertical diameter of do., .084; transverse diameter of do., .073; elevation of postzygapophyses from centrum, .122; elevation of neural spine above centrum, .292; length of diapophyses below, .130; length of a caudal centrum, .048; depth in front .050; distal width of femur, .250. I name this species in honor of my friend Professor Seeley, *Hypsirhophus seeleyanus*.—*E. D. Cope*.

GEOGRAPHY AND TRAVELS.[2]

African Exploration.—To the account given in our last number of the various expeditions engaged in explorations on the western coast of Africa, we have now to add these further details. M. le Comte de Semellé who started from Fernando Po in May, 1878, to explore the upper Niger and Benué, returned to that settlement on February 13th, last, and has forwarded an account of his discoveries to Europe.

M. Soleillet has also been obliged to return to St. Louis, Senegal from Sego on the Niger, in consequence of the refusal of the Sultan of Sego to allow him to pass through his territory.

The *Athenæum* (April 12, 1878) gives the following astronomical observations taken by M. de Brazza, Okanda's residence amongst the Bateke, 1° 34′ 59″ S., 11° 59′ 48″ E.; Obemba, an

[1] This journal, Feb. 23, 1878 (March number).
[2] Edited by Ellis H. Yarnall, Philadelphia.

Apfuru village, 1° 31′ 40″ S.; deserted spot, 0° 14′ N., 12° 17′ 30″ E.; Nghimi, 1° 37′ 56″ S., 11° 23′ E. The places are in the basin of the Ogowé with the exception of Obemba which is in that of the Congo. Four rivers crossed between 1° 30′ S. and 0° 30′ N. latitude flow eastward. Obemba is on the Alima, a powerful river which was navigated down to 12° 32′. The longitudes are reckoned from Paris.

Turning now to the eastern coast of the "Dark Continent," we find still more to record in the researches and enterprises undertaken both by scientific and religious societies. A survey is being made by the Portuguese for a railroad from the Delagoa bay to the Transvaal. The opening of the road from Dar-es-Salaam to lake Nyassa is progressing favorably. In December forty miles of the route had been traced out and no serious difficulties encountered. The dreaded tsetse-fly does not prevail in this region and bullocks and donkeys were employed in the work. Mr. Keith Johnston and his companion Mr. Thomson arrived at Zanzibar on the 5th of January. During a short detention at Aden the latter made an exploratory trip to Somali-land and he has sent a paper to the Royal Geographical Society containing an account of the region and its inhabitants, and of the geology and physical geography of the neighborhood. Mr. Johnston has engaged Chuma, Livingstone's favorite attendant, as headman in the journey to Nyassa. Since the death of his old master, Chuma has had much experience of travel in the country east of Nyassa.

For recent additions to our knowledge of that lake and its surroundings we are indebted to reports in the London *Academy*. It states that at a meeting of the Society of Arts a paper by Mr. Cotterill "On the Opening out of the Districts to the North of Lake Nyassa," was read, in which this country, walled in by the great Kondi mountains—believed to be more than 12,000 feet high—is spoken of as among the most beautiful and fertile tracts in Africa. Only among the Himalayas is scenery found at all comparable to that of the Kondi country. Mr. Johnston is especially instructed to examine this range of mountains thoroughly, their elevation, extent, the passes through them, etc. It constitutes the water-parting of the Rufiji and Nyassa systems. The *Academy* also notices a paper by Dr. James Stewart, read before the Royal Geographical Society, "On the Second Circumnavigation of lake Nyassa." The effect of this more recent survey (made September, 1877) is to shift the position of the lake twenty-four miles further west. Gold was discovered in the vicinity of Mount Waller which is 4,000 feet above the level of the lake. At the northern extremity of the lake a river called the Rombushe flowing into the lake was discovered.

It is now possible to steam over the 350 miles comprising the length of the Nyassa in forty or fifty hours, and, excepting a gap about seventy miles in length where cataracts intervene, to sail

from the London docks to the north end of the lake by way of the Zambesi and Shiré rivers.

Accounts of the progress of the exploration making on the western side of the Nyassa by the Missionaries from Livingstonia down to October 30, 1878, have been received in Scotland. The party left Livingstonia on August 12, 1878, and journeying first in a south-westerly direction, reached a mountain plateau some 4500 or 5000 feet above the sea-level. They then traveled through an open country, well watered, with a soil composed of disintegrated granite. Turning northwards they struck across the river Lintippe westwards and traveled for some time through a deserted but once populous country, Finally they reached Chivere's country, which is open, well watered and populous, but entirely devoid of trees. Reaching the coast south of the lake Chia they proceeded north along the coast and when last heard from had reached Kuta bay—Bandepe on Livingstone's map.

The *Nature* states that the exact position of Blantyre, which lies to the east of the Murchison Falls on the Shiré, and was never before accurately ascertained, has been found to be S. lat. $15° 45' 25''$ and E. long. $35° 14' 11''$.

Ill fortune has continued to attend the Belgian African Expedition. Lieut. Wauthier died of dysentery on the 19th of December last, near lake Chaia, a small body of water some eighty miles south-east of Tabora in Unyanyenbe. Dr. Dutrieux was with him at his death, but the remaining chief, M. Cambier, when last heard from, had passed Tabora on the road to Mœne, M. Dutalis has arrived at Zanzibar and will hereafter command the expedition. Mr. H. M. Stanley accompanies him and will act as guide and interpreter. Capt. Popelin will also soon leave Belgium to execute the plan of forming a chain of stations across Central Africa from Zanzibar to the Loango coast. The means for this important undertaking are supplied by the King of the Belgians.

Another Missionary of the (English) Church Mission to the Victoria Nyanza, Mr. Penrose, has met with a violent death at the hands of the natives. He was on his way to the Nyanza and was attacked and murdered at nearly the same time as the death of Lieut. Wauthier occurred and near the same lake Chaia. It is stated that the attack was made in revenge by marauders who had been previously defeated by the Abbé Debaize of the French Scientific Expedition. Letters have been received from the latter, in Paris, dated October 17, 1878, near Tabora, the capital of Unyamalzi. He had so far been most successful, having accomplished his march with great rapidity, without loss either in men, supplies, or instruments, and was in perfect health. He states that the power of the Arabs wanes daily, and their place is being taken by the English. The power of the Sultan of Zanzibar is merely nominal. The Sultan reigns but the English Consul gov-

erns. Two of the French missionaries from Algeria have died, one of them by illness and the other having been killed by a lion. Letters down to October 17, 1878 have been received by the London Missionary Society from their mission at Ujiji on lake Tanganyika. The death from apoplexy of the leader of the party, Rev. Mr. Thomson, is announced. The Arabs report the grass in the Lukuga (Cameron's supposed outlet of the lake) as having been swept away in the last rainy season by the rising of the lake waters. They say it is now an out-flowing river, and one of them had gone down it to the Kamolondo (?) lake.

We learn from the *Nature* that a German Scientific Expedition under Herr C. Denhardt has recently explored the course of the river Dana They only advanced about sixty miles into the interior. They could hear nothing of Mount Kinea, and it is probable the stream does not take its rise from its slopes as hitherto supposed.

Mr. Mackay of the English Church Missionary Society reached the south-eastern shores of the Victoria Nyanza at Kagei in July, 1878. Having received a conciliatory message from Lukongeh, chief of the Ukerewe, by whom his colleagues, Messrs. Smith and O'Neill were killed, he visited him. Lukongeh stated he had no quarrel with white men and that the death of his friends was caused by their interference in the affairs of an Arab. On his return to Kagei Mr. Mackay met the Rev. Mr. Wilson, who had crossed over from Uganda and the two returned together to King Mtesa's, after Mr. Mackay had succeeded in putting together the sections of a small steamer in which he transported across the lake the stores of machinery, tools and useful articles sent out for the instruction of the natives. The British Government has been informed of Mtesa's intention to send an embassy to the Queen. He is anxious to open up a direct road from the Nyanza to the coast through the Masai country. He is ready to welcome Englishmen, but desires no more dealings with the Arabs, and is very much afraid of the Egyptians. Rumanika, the old King of Karagwe is dead, and Mtesa has dispatched an army to secure the throne for one of the deceased king's sons.

The Missionaries sent out by the Society by the Nile route arrived at Regiaf above Gondokoro about November 7th.

At a conference of telegraph engineers and others held at the Royal Geographical Society's rooms in London, on the 6th of January, last, a report was adopted recommending a route for an overland telegraph from Khartum to Pretoria. The following are the sections and distances on this route:

		Geographical Miles.
1.	Khartum to Gondokoro	645
2.	Gondokovo to Mtesa's capital	300
3.	Mtesa's to south side of Lake Victoria	300
4.	Lake Victoria to Unyanyembe	130
5.	Unyanyembe to Bagomoyo	370

		Geographical Miles.
5*a*.	Bagomoyo to Zanzibar	35
6.	Bagomoyo to north of Lake Nyassa	290
7.	Down Lake Nyassa to Livingstonia	300
8.	Livingstonia to Tete	145
9.	Tete to Pretoria	820
		3335
	To which must be added for deviations, say about one-fifth, viz:	667
	Making in all	4002

The practicability of making and keeping open such a line is asserted by Capt. Cameron, Mr. H. M. Stanley, Mr. Ziegler, Director of the London and Red Sea Coast Telegraphs, Sir. F. Goldsmid, of the overland Indian Telegraph, and others. Meanwhile the British Government has decided to lay a cable from Aden to Zanzibar, thence to Port Natal via Mozambique and Delagoa bay. Madagascar and the Mauritius may also be connected with this line.

MICROSCOPY.[1]

American Society of Microscopists.—This Society, which was the outgrowth of the Microscopical Congress at Indianapolis, last summer, is making arrangements to meet at Buffalo on Tuesday morning, August 19th, with the probability that its sessions will continue until Friday night the 22d. This will leave ample time for those who wish to attend also the meeting of the American Association for the Advancement of Science, at Saratoga, on the 27th of the same month. The people of Buffalo have organized a local committee, with sub-committees on finance, on transportation, on accommodations and rooms, on entertainments, and on microscopical soirée. The place for headquarters of the Society, and for holding the meetings, has not yet been finally decided upon, but will soon be announced. Arrangements are being made with great care and consideration, and those who remember the superb reception given in that city to the A. A. A. S. a few years ago, will need no assurance that the meeting will be made pleasant as well as profitable.

National Committee on Micrometry.—This committee, in the formation of which most of the active microscopical societies of the country have taken part, has been organized with the following officers and members: F. A. P. Barnard, LL.D., president of Columbia College, N. Y. city, chairman; R. H. Ward, M.D., Troy, N.Y., secretary; George E. Fell, C.E., Buffalo, N.Y.; Henry Jameson, M.D., Indianapolis, Indiana; Prof. S. A. Lattimore, Rochester, N.Y.; Prof. Edward W. Morley, Hudson, Ohio; Joseph G. Richardson, M.D., Philadelphia, Pa.; Prof. Stephen P. Sharples, Boston, Mass.; Prof. H. L. Smith, Geneva, N.Y.; Prof. Albert H. Tuttle, Columbus, Ohio; J. J. Woodward, M.D., Wash-

[1] This department is edited by Dr. R. H. Ward, Troy, N. Y.

ington, D.C.; Lester Curtis, M. D., Chicago, Ill.; the San Francisco society is represented on the committee, though not yet by a western man. The committee is already engaged in discussion of the large number of reports and letters that have been received on the subject.

LEAD CELLS.—Cells may be made readily, and at small expense, from the thin sheets of lead with which tea boxes are ordinarily lined. This material may be obtained from any grocer, and is prepared expeditiously by the following method: It should be smoothed by rubbing and slightly moistened with water, so that when placed upon a turn table it will adhere sufficiently to be marked with a lead pencil. Using thin glass covers as patterns concentric rings may be traced and then removed by means of the sharp point of a penknife. The rings thus formed may be fixed upon the slide with cement, and the depth of the cell increased by placing several of these upon each other, allowing a sufficient interval for partial drying. Shallow cells in particular are formed with the greatest ease by this method, and they seem to be durable.—*M. A. Veeder, Lyons, N. Y.*

[Cells of paper or cardboard are made with great success in the same way, on the modern turntables. Tin or lead cells are generally attached to the slide with Kill's cement or shellac varnish. —ED.]

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SCIENTIFIC NEWS.

— The National Academy of Sciences, held its spring session in Washington, commencing April 15th. A number of important papers were read, and election for officers was held. This resulted in the election of Prof. Wm. B. Rogers, of Boston, as president, and Prof. O. C. Marsh as vice-president; Prof. J. H. C. Coffin, home secretary; Prof. F. A. P. Barnard, foreign secretary; Fairman Rogers, treasurer; Professors Baird, Agassiz, Newcomb, W. Gibbs and A. Hall, and General M. C. Meigs, members of council. The new members of the Academy elected at this meeting are Prof. Cleveland Abbe, distinguished for his researches in meteorology; Prof. J. W. Farlow, botanist, of Harvard University; Dr. Horatio C. Wood, of Philadelphia, prominent in biology; and Prof. J. Willard Gibbs, of New Haven, a student of mathematical physics. The following are among the papers read: S. H. Scudder, The Palæozoic cockroaches; S. Weir Mitchell, The relations of neuralgic pains to storms and to the earth's magnetism; Joseph LeConte, On the extinct volcanoes about Lake Mono, and their relations to the glacial drift; E. D. Cope, On the extinct species of the rhinoceros and allied forms, of North America; E. W. Hilgard, The loess of the Mississippi and the æolian hypothesis; G. K. Gilbert, On the stability and instability of drainage lines; C. V. Riley, The hybernations and migrations of *Aletia argillacea* (the parent of the cotton worm); A. Agassiz, Report on dredgings in

the Carribean sea by the U. S. Coast Survey steamer *Blake*, Commander John R. Bartlette, U. S. Navy, commanding; G. J. Brush, On a mineral locality in Fairfield county, Connecticut; J. S. Newberry, On the great silver deposits recently discovered in Colorado, Utah and Nevada.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, Feb. 11.—The President, Dr. Ruschenberger read an extract from a letter from Dr. Siegfried, U.S.N., descriptive of the aborigines of the island of Botel Tobago. Rev. H. C. McCook gave an account of his studies upon the habits of leaf-cutting ants of Texas.

Feb. 18.—The President in the Chair. A paper entitled, On the structure of the Chimpanzee, by Dr. H. C. Chapman was presented for publication. Dr. Leidy exhibited some specimens of *Bothriocephalus latus* which had been obtained from a Swedish woman, this tape-worm appeared to be very rare in this country, being the first he had ever seen. Dr. Leidy also gave the results of his examination of the second chimpanzee, which recently died at the Zoölogical Garden, stating that in this specimen the cerebrum fairly covered the cerebellum; longitudinal *valvulæ conniventes* were found in the middle of the small intestine, and forty-five Peyer's patches were counted. The development of the laryngeal pouch was also considered.

NEW YORK ACADEMY OF SCIENCES, April 7. — Prof. J. S. Newberry read a paper on the occurrence of gold with the silver ores of Nevada.

April 21. — Prof. Arnold Guyot presented a paper on the topography of the Catskills.

April 28.—Prof. J. S. Newberry remarked on the devices employed in nature for the distribution of the seeds of plants.

BOSTON SOCIETY OF NATURAL HISTORY, April 16. — Dr. S. Kneeland spoke on the mineralized phosphatic guanos of the Pacific islands.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—April. Observations on the structure of cells and nuclei, by E. Klein. On the apical and oral systems of the Echinodermata, by P. H. Carpenter. The development of the earth-worm, by N. Kleinenberg (shows that the brain is formed independently of the ventral nervous cord, and criticises Semper's views as to the derivation of the nervous system of vertebrates from that of worms). The Nematoid Hæmatozoa of man, by T. R. Lewis (confirms Manson's discovery of the migration of a human hæmatozoön from the blood of a mosquito, and records the life-history of the *Filaria sanguinis-hominis*).

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FORM OF SEEDS AS A FACTOR IN NATURAL SELECTION IN PLANTS.

BY ROBERT E. C. STEARNS.

THE present aspect of the fields in the immediate neighborhood of the south grounds of the University of California, at Berkeley, when compared with their general appearance five years ago, when the flora of the locality was first noticed by me, exhibits a marked contrast; and though during this time the varying character of the vegetation from year to year attracted my attention, the altered physiognomy of the fields particularly impressed me this past season, and curiosity has led me to seek for the causes which have produced what may be regarded as a most striking change.

The complexity of questions of this kind is increased, not only through the simpler factors involved, some of which are given below, but by the sequence of relationship of such factors to each other, which it is difficult to detect.

The climatology of the seasons during which such changes have been progressing;—the tillage of proximate lands, and the introduction of new plants, or of plants new to a locality, through this agency or by other artificial means more or less direct, which follow the settlement of a region;—other changes which follow through neglect of tillage, as where the cultivation of farming lands is abandoned, as is generally the case where such lands are divided and cut into small parcels for village or town plats or lots;—these are a few of the more conspicuous agencies which produce changes of the kind mentioned herein, in the local flora of such neighborhoods. Again, the time required for the growth

of a plant, from the sprouting of the seed to maturity, differs greatly in different plants, and the seeds of some plants germinate in much less time than the seeds of others. From this cause the aspect of the fields changes during the same season; those plants whose seeds start quickly and attain maturity in the shortest time, dominate for awhile and give one aspect to the fields in the first part of the season, and those plants whose seeds sprout slowly only reach maturity after the earlier have passed their prime or died, then dominate[1] and later in the season give to the fields a a different complexion or appearance.

The occurrence of these changes and the domination of this or that plant inside of or within the number of plants which form the flora of a certain region, may be conspicuously modified, in one year or season as compared with another, by the character of the season as previously referred to. As some plants thrive best with only a moderate supply of moisture, and are dwarfed, decreased in number of individuals or suppressed by the "drowning" of the seeds as the farmers call it, through excess of "wet" —so the latter might be highly favorable to the germination of the seeds and earlier development of the plants of some other species, which in normal or ordinary seasons would appear much later.[2]

The effect of only one such season might extend through several seasons, and materially modify the landscape features in its annual plants for a period of many years.

Without further enlarging in this direction on certain points which have been referred to, as they cannot properly be passed unnoticed, attention is called to another class of factors, not generally recognized, but of sufficient importance not to admit of exclusion, wherein natural selection is illustrated as performing its part in a different way.

The domination of "the fittest," the character of a season con-

[1] Thus *Madia sativa*, popularly or unpopularly known as "tar-weed," and obnoxious to pedestrians on account of its gummy exudation which injures clothing, though inconspicuous in early summer, later in the season becomes a prominent plant.

[2] In considering this point the frequently recurring discussion of what may be entitled "Cheat *vs.* Wheat," is brought to mind; some farmers contending that in seasons of unusual "wet" the wheat turns to cheat; others that the cheat, which in ordinary seasons is kept back, suppressed by the wheat (which makes the earliest start and quickest after growth, therefore maturing first), in unusually wet seasons gets the start of the wheat and dominates the field for that season. (Cheat is the local or vulgar name for *Lolium temulentum*.)

sidered, has been inferentially if not directly shown, where the effect of an unusually wet season is referred to; so certain plants which now dominate in my immediate neighborhood illustrate how natural selection has assisted, to say the least, in producing the change in the open fields near my residence in Berkeley, through the advantage which one form of seed has over seeds of a different form. And this aside from its interest to the scientific observer, is of special interest to the farmer, for it enters into the economics of his business, as may be seen further on.

Only a few years ago the entire region hereabout, from the hills to the shore of the bay, was either farmed or used for pasturage. Where not tilled, over large portions of this area, the wild mustard (*Brassica nigra*) abounded, and was regarded by the farmers as a pest; it grew and thrived nearly everywhere, and often attained a height sufficient "to hide all of a standing horse but his head." During later years the mustard has surrendered a part of the field to an (introduced?) turnip and radish, plants of the same order, with smooth seeds, and all three of these have been giving way, gradually yielding to other plants, native and introduced.

The mustard may, in some localities, regain in part its lost supremacy, through the assistance of man, as the seed within a few years has become of economic importance, and is now prepared for culinary purposes, and is also on the list of products in the export trade of the State.[1]

The principal plants within the more limited area first mentioned in this paper, to which these smooth-seeded *Cruciferæ* have been gradually yielding, have seeds of a different form. One of these is the *Alfillarilla*, or "filaree," by which name it is more generally known, a plant which is closely related to the geraniums, if we may judge from analogies of form in leaf and flower, structure of seed receptacle and shape of seeds. This alfillarilla, as it is called by the Spanish Californians, is an *Erodium*, and two species grow here, namely, *E. cicutarium* and *E. moschatum*.[2]

[1] In 1875, 1013 centals, valued at $4849; 1876, 5458 centals, valued at $18,314; 1877, 5065 centals, valued at $15,412, and in 1878, 7552 centals, valued at $21,689, were exported to foreign countries, making a total for the four years of 19,088 centals of the value of $60,264.

[2] Cattle eat these readily and appear to be fond of them, but the latter species especially is not a desirable plant for milch cows, as it gives a disagreeable odor and taste to the milk.

This genus is a form of "cranesbill," and as will be seen by Fig. 1, and its gynæcium, Fig. 2, is somewhat like that of *Geranium maculatum*, as figured in Gray.

Crane's bill (Erodium) or Alfillarilla. From nature.

The latter figure, with the sepals removed, shows the ovaries with their slender bearded[1] styles or awns (Figs. 3 and 4 enlarged) *in situ*, cohering to the elongated axis of the receptacle.

It will be observed upon examination that the ovaries are in fact a barb-shaped sheath enclosing the seed, the surface of which is covered with short stiff hairs or small bristle-like spines visible to the unaided eye, but of course more conspicuous through a common lens. The tip of the barb is also peculiarly pointed and curved; produced from the upper end of the ovary (that opposite to the tip) is a thread-like process or style an inch or more in length, varying in different specimens, so that the ovary as a whole may be compared to a tiny arrow, which it much resembles.

Now if we examine an unripe specimen before the sepals have separated from it (Fig. 1), we shall find four to five of these miniature arrows (carpels) side by side, closely fitting together, being snugly packed around the prolonged central axis of the gynæcium, the base of which is sufficiently expanded or swollen to receive the tips.

After the blossom has withered and the ripening process

[1] It is presumable that the Spanish name *Alfillarilla* was suggested by these delicate filaments.

advances, it will be found that the arrows (ovaries) in these little bundles, or quivers, if it be allowable to so name them, exhibit a tendency to separate from the central stalk or axis of the receptacle, first curling upwards and finally falling off, or are blown out and distributed by the wind.

As soon as the ovaries are detached as above, their styles commence twisting (see Figs. 5, 6 and 7), and the delicate threads, as seen upon and along the slender shaft or style, are consequently thrown out at increased angle (sometimes at a nearly right angle), so that the entire ovary now presents somewhat the appearance of the skeleton or frame, as it were, of a parachute, which after a breeze has passed and the air is calm, causes it to descend vertically, barb downward, so that the tip first touches the ground; the end of the tip is also barbed, so that if the soil at the spot where it alights is at all loose, it holds on. If the weather is dry the style or awn becomes still dryer, which causes it to twist still more, and the torsion caused by increased desiccation, turns it deeper and deeper; while if the atmosphere becomes damp or a rain occurs sufficient to moisten the slender style, though but little moisture is required to relax the torsion, the bite or grip previously made is not lost, because with the softening of the style the barb or ovary is not twisted out; whatever hold has been gained is retained, and the torsion renewed with recurring desiccation, and so the process of planting goes on.

The small bristles on the surface of the ovary or sheath are set obliquely upwards to the axial length and assist in the process of planting. It will be seen that every alternation of atmospheric conditions, characterized by positive moisture or dryness, assists in the operation.[1]

The luxuriant growth of the cultivated geraniums in California is well known. In and around Berkeley nearly every yard has many plants of one or more varieties. On my premises are numerous vigorous plants of large size and of many varieties, including Pelargoniums.

[1] This is easily illustrated by the following simple experiment: Take a tumbler and fill it with sand; select specimens of the gynæcia or receptacles which are beginning to turn brown or approaching ripeness, that is while the seeds complete with barb and shaft are straight; place the barb sufficiently deep into the sand so that its tip is fairly set; it will soon be noticed as the ripening progresses, or as the awn or shaft begins to dry that it also begins to curl or twist, and that in curling it buries the barbed ovary deeper and deeper, as turning a corkscrew carries the same deeper and deeper into a cork.

The question naturally occurred, why have not these ornamental forms which have the great advantage over their wild relatives of the protection and fostering care of man, spread like the unprotected *Erodium* and divided the field with it or driven it out? The seeds are not infertile, for under the shade of the sturdy plants which produce them, protected during the hot dry summers by the leaves which fall from the parent plant and make the thin mulch which covers them, with infrequent and slight sprinkling during the long rainless season, hundreds of young plants may be seen in the fall which have sprung from the loose and slightly moistened soil and acquired their second pair of leaves. The carpels are of the same form as those in *Erodium;* few persons could detect any difference, and the awn or style twist in the same way. Upon critical examination, however, it was found that the tip (insertion point) of the carpel was covered with *soft silken hairs instead of rigid bristles*, too soft to act as barbs, and the insertion point is neither as sharp or stiff nor curved the same as in Erodium.

The seeds of all of these foreign forms which have been examined by me in this connection, are apparently dependent for distribution chiefly on the winds, for the delicate filaments along the style if not longer are more numerous than in Erodium, so that when the twist or torsion has occurred, they present a form well adapted for distribution by flight.

Darwin has noticed the advantage which winged seeds have in this respect, as well as those plants whose seed cups or receptacles have a rough exterior, which get caught in the hair or fleece of animals and are thereby transported from place to place. In this way also the seeds of the geraniums have some advantage, but as compared with those of Erodium, so far as planting by natural methods is considered, the advantage is conspicuously in favor of the latter.

I do not know how it is with the cultivated varieties referred to in their native country, neither can I assert how it might be with our Erodium forms if transplanted to another region; a different environment might induce a gradual modification in those peculiarities which in the environment of Berkeley are important factors in their propagation and the extension of their geogra cal domain. It is not difficult for a person who is the cultivation of plants, and who has had an

widely separated regions with different soils and climates to conceive of conditions which might give to Erodium a rank succulent and tender growth, which, continued for a few years might differentiate the rigid bristles and barb of its ovaries in the direction of greater flexibility; or on the other hand to modify the soft nap or pile on the surface of the ovaries as well as the flexible tip of the foreign geraniums in the direction of rigidity or spine-like stiffness. Those influences which induce succulent or ligneous tendencies in plants are to a great extent the factors in such variation.

The seeds of geraniums found in the highlands of Uruguay, as well as the seeds of certain other plants, exhibit the same interesting peculiarities.[1]

Notwithstanding the browsing of cattle the Erodium gained upon the previously conspicuous forms. Within the past two years, however, it has been losing ground, in some places more

[1] An exceedingly brief outline of this paper was read by me before the California Academy of Sciences, June 17th, 1878; subsequently my friend, Mr. X. Y. Clark, sent me the following clipping from *Nature* of March 1, 1877, which I had not previously seen:

"*Hygroscopic Seeds.*—I have lately received an interesting letter from Fritz Müller, in St. Caterina, Brazil, on the subject of hygroscopic seeds. He tells me that in the highlands of the Uruguay he has succeeded in discovering more than a dozen grasses, as well as a species of geranium, whose awns are capable of hygroscopic torsion. He has been so kind as to send me specimens of the grass-seeds, and many of them appear to be as beautifully adapted as those of Stipa, Avena, &c., for penetrating the ground in the manner which I have elsewhere described (Trans. Linn. Soc., vol. 1, part 3, p. 149, 1876). The most curious among the specimens received are the seeds belonging to the genus Aristida. In one of these the awn is longitudinally divided into three fine tails, six or eight inches in length, each of which twists on its own axis when the seed is dried. These tails project in three directions and more or less at right angles to the axis of the seed, and Fritz Müller states that they serve to hold it in an upright position with its lower end resting on the ground. The seed is pointed and barbed in the usual manner, and when it is made to rotate by the twisting of the awns, it evidently forms a most effectual boring-instrument, for Fritz Müller found many seeds which had penetrated the hard soil in which the parent plant was growing. Another species of Aristida is interesting to me, because it illustrates the explanation which I gave of the torsion of the awn of Stipa, namely, that each individual cell of which the awn is composed is capable of torsion, and their combined action results in the twisting of the whole awn. Now in this species of Aristida each of the three tails into which the awn is divided is capable of torsion on its own axis, and as the seed dries they twist up into a perfect three-stranded rope, just as the component cells combine to produce the rope-like twist of the Stipa awn. And as the tails wind together and form the strands, the seed is made to rotate and thus bury itself in the ground.

"Down, Beckenham, February 19. FRANCIS DARWIN."

The Transactions referred to in Mr. Darwin's foot-note are not within my reach, and the article referred to by him, is unknown to me. I am curious to learn how far my observations and comments, made quite independently and without knowledge of anything elsewhere written, may agree with or sustain previous writers, or be corroborated and sustained by their observations.

The question naturally occurred, why have not these ornamental forms which have the great advantage over their wild relatives of the protection and fostering care of man, spread like the unprotected *Erodium* and divided the field with it or driven it out? The seeds are not infertile, for under the shade of the sturdy plants which produce them, protected during the hot dry summers by the leaves which fall from the parent plant and make the thin mulch which covers them, with infrequent and slight sprinkling during the long rainless season, hundreds of young plants may be seen in the fall which have sprung from the loose and slightly moistened soil and acquired their second pair of leaves. The carpels are of the same form as those in *Erodium;* few persons could detect any difference, and the awn or style twist in the same way. Upon critical examination, however, it was found that the tip (insertion point) of the carpel was covered with *soft silken hairs instead of rigid bristles*, too soft to act as barbs, and the insertion point is neither as sharp or stiff nor curved the same as in Erodium.

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The spikelet as a whole may be regarded as a wonderfully ingenious, compound and effective barb, having through the angle of its various parts and the length of the awns, all of the advantages of the parachute form which Erodium and the cultivated geraniums referred to derive from their twisted styles with fine lateral hairs, for floating in the air *and for poise in ultimate descent.*

The principal advantage which Erodium has over this Hordeum is in the hygroscopic torsion of the styles[1] or awns; this is more than balanced by the preponderance of barbs and bristles in Hordeum, all of which are set at some angle outward and upward, while the spoon-shaped basal nib, arrow-head or insertion point, whichever it may be termed, is perhaps equally well adapted as the same part in the carpels of Erodium, for biting and holding on; once inserted, every motion it receives, whether from the wind or other source only inserts it deeper and deeper, and in this the nib or insertion point is assisted by the other parts of the spikelet. Another and probably the chief advantage which the barley-grass has over Erodium is in the greater number of seeds (three in a spikelet) in a single plant; recurring again to the fact that cattle dislike it on account of its wiry, prickly character, which gives it almost perfect immunity or protection from their browsing, it is easy to perceive why it has become nearly if not quite "master of the situation."

To the farmer it is a pest and to the pedestrian a nuisance, as the spikelets stick into the trowsers around the foot, working in deeper and deeper with every motion, often crawling upwards as far as the top of the boot-leg, where if the stocking is long and extends above, it catches and follows down into the foot, irritating the flesh and compelling a halt in order to remove the annoyance.

Under a microscope lens the main barb (insertion point or nib) is an interesting and curious object; the unshaded edges (see figure) and the tiny barbs upon the same are translucent, being

[1] "A wild oat * * * * * the *A. sterilis* of botanists, is remarkable for the hygrometric properties of the seed. Two grains usually grow together, and they have a stout, bent and twisted awn. When the oat is ripe it falls out of its glume, and in warm dry weather may be seen rolling and turning about on its long ungainly legs as they twist up in consequence of their hygrometric quality. They turn and tumble about till their awns are so twisted that they can twist no further. They then remain quiet till the dew falls, or they are moistened by a shower, when they rapidly untwist and run about as if anxious to escape from the wet."—*Baird's Dict. Nat. Hist. p.* 27.

nearly pure silica; so also are the minute barbs upon the awns; and the short bristles on the surface of the ovaries in Erodium resemble, in miniature, the spiny bones in the dorsal fin of a perch.

Other bearded or barbed-seeded or rough-burred plants have increased in several places within the region referred to in this paper, among these are the burr-clover (*Medicago denticulata*) and the thistles (*Centaurea melitensis* L., and *C. solstialis* L.), both introduced species; the barley-grass, however, has the advantage over all others and is likely to maintain it.

——:o:——

A SPECULATION ON PROTOPLASM.

BY PERSIFOR FRAZER, JR.

THE researches of comparative anatomists in late years have thrown much light upon the mode of development of the germ or embryo to the adult form of the species from which it is derived, and by the labors of Haeckel, Huxley, Cope, and others, much encouragement has been offered to the hope that man will yet push his knowledge of the processes of the development of life at least so far into their infinitesimal beginnings that the highest powers of the microscope and the most delicate appliances of physical science can no longer aid him. In this gradual triumph over what at first seemed insurmountable difficulties, many lines of interesting speculation are opened up, which, though lacking the permanent value of demonstration, are not without a certain use.

One of these is connected with the material out of which these wonderful structures are built; a material seeming to form the common point of intersection of all lines of organisms. For the latter, though widely separated in their several states of perfect development, when traced towards their origin, exhibit more and more striking resemblances and analogies; and they consist of a common substance, namely, the ultimately structureless (or amorphous as it is sometimes perhaps too hastily called) protoplasm or sarcode.

This wonderful substance which composes the simple cell of plant and animal, is capable of a distinct and individual life, and its methods of growth and multiplication (or rather division) have been beautifully demonstrated by many eminent naturalists. And wherever the phases of this chameleon may be observed, each is the easily recognizable child of all it has passed, and the common parent of all beyond and above it, howsoever divergent may be the path. But it is the vulgar error to misunderstand this analogy (as in the relations of man and monkey, etc.) when criticizing the doctrine of evolution. For only on the trunk do all divergent forms unite. No *bough* is parent to another, but they are brothers of the same parent stem.

This ultimate organic matter, or common building material, if not identical in chemical composition, is at least always composed in the main of the same few elements.

Robin's composition of the amniotic fluid of a fecundated ovum[1] contains:

	Per thousand.
1. Water	991.00 to 975.00
2. Albumen and mucosine	0.82 to 10.77
3. Urea	2.00 to 3.50
4. Creatine and creatinine ... not estimated.	
5. Sodium lactate ... trace.	
6. Fatty matters	0.13 to 1.25
7. Glucose ... not estimated.	
8. Potassium and sodium chlorides	2.40 to 5.95
9. Calcium chloride ... trace.	
10. Sodium carbonate ... trace.	
11. Sodium sulphate ... trace.	
12. Potassium sulphate ... trace.	
13. Calcium and magnesium ... trace.	
14. Phosphates and sulphates	1.14 to 1.72
Sum	997.49 to 998.18
Leaving undetermined, and to be divided between creatine, creatinine, sodium lactate, glucose, chlorides, sulphates, etc., and loss	2.51 to 1.81

This analysis does not, it is true, represent protoplasm from the simplest structures, but that which is used in organic edifices of a relatively high state of complexity; nevertheless the table is valuable as showing that despite the very heterogeneous nature

[1] See Flint's Text-book of Physiology, p. 903.

of this fluid, the number of elements which essentially compose it is few, thus:

Water	H_2O	
Albumen	C, H, N, O, S, slight variations in composition.	Molecule not known.
Mucin	$C_a H_b N_c O_d$ variable.	
Urea	$NH_4(CN)$	
{ Creatine	$C_4 H_9 N_3 O_2$	
{ Creatinine	$C_4 H_7 N_3 O_2$	
Sodium lactate	$Na_2(C_3 H_4 O_3)$	
Fatty matters	$C_a H_b O_c$	0.013 to 0.12 p. c. per thousand.
Glucose	$C_6 H_{12} O_6$	
Mineral salts	KCl NaCl $CaCl_2$ Na_2CO_3 Na_2SO_4 K_2SO_4 traces.	
Magnesian and calcareous phosphates & sulphates	{ $Mg_3(PO_4)_2$ $Ca_3(PO_4)_2$ / $MgSO_4$, $CaSO_4$ }	0.11 to 0.17 p. c.

By glancing at the above tables it will be seen that the bulk of this fluid is made up of the type elements H^{I} O^{II} N^{III} C^{IV}, and these are *essential*, while sulphur, sodium, potassium, chlorine, magnesium, calcium and phosphorus are more or less accidental, or at least make up but a small part of its substance (*i. e.*, 0.4 to 1 p. c. at the highest estimate).

Even here, then, in a highly complex animal fluid, one about to commence the architecture of the various parts of one of the most complex animals in nature—man; the bricks, though most diverse in form, color and durability, are almost altogether composed of the same four simple substances which make the waters, the atmosphere and the plants, viz: C N O H.

But this conformity to rule, which would make these elements the only four necessary constituents of organisms, though close, is not exact. Sulphur always occurs, though in small and varying quantity. Phosphorus is generally present as an inorganic compound.

Nor is it known, (1) how greatly this material may vary in constitution and still subserve the needs of the growing thing which assimilates it; (2) how greatly the needs themselves of a race of growing things may alter with gradually changing circumstances. Has it always been necessary to build living things out of three combustibles and a diluent? When one attempts to speculate upon the *possible* answers to these now unanswerable questions, the difficulties crowd thick upon him. In the early history of the universe (or better, of our own planetary family) was it possible for living beings to exist? What constitutes a living being? Some physiologists hold nutrition and reproduc-

tion to be the necessary concomitants of life. Others reject the latter on the ground that animals, like the working bees and the sterile ants, not to speak of the hybrids, do not fulfill it.

All seem to agree that life is a manifestation of force, but so is crystallization. Crystallization, or inorganic life, however, seems to differ from organic life in this, that the ultimate components of the structure due to the latter are cells or irregularly-shaped sacs with or without skin, nucleus and nucleolus, and if this cell is broken up into parts it does not simply become two smaller but similar bodies, but either commences to disintegrate and fall to pieces or remains a broken and *dead* cell. In the former case the smallest constituent part yet reached is similar to, or at least connected by, rigid geometrical laws with the largest form in which it manifests itself.

By inductions based by mineralogical microscopists on the analogies in the behavior of matter in the magnetic field and in polarized light, it is rendered probable that each of the constituent molecules of a crystal is allied to the crystal itself in its form, and that both forms are due to what might be called stereo-polarity, or the interplay of several (*i. e.*, more than two) polar forces acting along different axes, which holds the molecules of solids together, and gives the latter their characteristie forms. The results would necessarily be the repetitions of the same form or of the crystallographic analogues of that form (*i. e.*, different derivations in the same crystal system) and the growth of monsters which are so often met with.

Supposing this definition then to stand, the difference between organic growth and crystal growth would be that in the one case the product is dissimilar, in the other similar to the component parts.[1]

But is a fundamental distinction reached here?

Is it possible that beyond the range of the microscope there are minute forms composing these cells which are each in itself geometrically regular, yet constituting in the aggregate an ungeometrical body as the starting point for life-building?

Considering molecules of matter as inert and acted upon simul-

[1] The curious effects produced by the twin structure of crystals, as for example the production of an apparently hexagonal crystal by the union of several which are rhombic (chrysoberyl, etc.), offers no exception to the rule since the analogy spoken of still exists between the rhombic (?) molecule and each twin.

taneously, but with different degrees of force in different directions, then if those similar molecules were distributed evenly in any menstruum, there would necessarily result such a grouping of them as to form definite geometrical figures, whether these forces were those of attraction or repulsion or both together. It is possible, but not proven, that the different atomicities or atom-saturating powers of different elements may be due to different numbers and positions of these magneto-polar axes. From the grossest to the smallest manifestation of growth force; from the long neck of the giraffe to the segmentation of the ovum, there is observable but the interaction of polar forces, producing results, however, which are most dissimilar. In such large masses as we can see, these are modified by each other, in great measure, so as to produce curves instead of straight lines, as the pendulum does when struck sideways during its plane oscillation; but a multiplicity of polar forces thus interacting will account for all the phenomena.

There is no ground for supposing that these forces so patent in masses large enough for us to observe, cease to act upon matter even when in the state of finest comminution. And if they do, the result of a concourse of molecules, whether of organic or of inorganic origin, under the direction of polar forces must produce geometrical form.

The only means of testing whether this is the case in these organic cells (since the bodies, if they do exist, must be too small to be capable of being seen under the most powerful microscope) is by the employment of a more delicate test than the recognition of form, and such a test is the modification of color by transmission through thin films of them. The waves of light in passing between the constituent atoms of a body, experience a retardation proportionate to the density of the medium; which is only saying proportionate to the mean distance of the atoms apart, which again is governed by the amount of the attractive force exerted in a given direction. Bodies in which the density is equal in all directions retard the passage of light equally in all directions, whereas if the density be different in different directions the retardation will be different also and a new phenomenon will result.

It is known that nearly all organic structures have the property of polarizing light, and hence are built up by the interaction of polar forces of different intensity, and if the first proposition

be correct, the establishment thus of the existence of several different independent lines of force renders the existence of a geometrically constructed organic unit at least probable.

Why these smallest organic molecules do not construct the perfected product on their own model, while the analogous crystalline molecules do, is a problem for future solution.

If the sarcode or protoplasm be susceptible of slight chemical changes, and in fact suffers such changes without losing the power to fulfill its function of repairing waste tissue, then in the progress of the decay of worlds, and the changes of external conditions consequent upon it, Darwin's law of survival must inevitably be felt where an accidental alteration of the substance of the sarcode and the resulting changes impressed upon the structure enabled one animal to live where others perished. The formation of more combustible compounds, and the increase of the capacity of alimentation, for instance, might balance the tendency of the atmosphere of a cooling earth to depress the temperature of the blood below the living point. But why should it only exert its recuperative energy in the direction of maintaining the present condition of things? An amount of plasticity equal to this need is quite capable of changing the conditions of life themselves, and instead of rendering it possible for *man* to exist with blood at 99° Fahr., in an arctic world; to manufacture of man and his terrestrial companions, beings to whom that temperature would be normal and salutary.

To a limited extent it seems as though we were justified in accepting a difference of this kind in our present organic nature. How else than by a sarcode of different chemical constitution are the physical differences of race to be accounted for? How, indeed, is evolution to be accounted for according to the Darwinian explanation?

And if the change to varieties is thus produced, why not to species, genera, families, groups, orders, classes, sub-kingdoms;—why is it not possible that the very kingdoms of life and the forms peculiar to them may be altered in this way to suit the gradually changing external conditions of nature? The prejudice in our minds against the possibility of any living thing existing on the surface of the sun is based upon various conditions there, which in our experience are inconsistent with life. Amongst others may be mentioned, that to the best of our knowledge, 1st,

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ON THE FERTILIZATION OF SEVERAL SPECIES OF LOBELIA.[1]

BY WILLIAM TRELEASE.

AMONG our wild flowers few are more conspicuous than the cardinal flower (*Lobelia cardinalis*), which, by its racemes of large, velvety red flowers, attracts many a wanderer into otherwise very unattractive marshes. The large blue lobelia (*L. syphilitica*) forms also a very conspicuous feature of such places in late summer and early autumn, while the Indian tobacco of the herb doctors (*L. inflata*) is known to everybody. In addition to these, some twenty other species grow wild in North America, and lovers of flowers know well the cultivated creeping lobelia (*L. erinus*), with its pretty blue and white flowers. To any observer not a botanist these are easily known as lobelias by their two-lipped flowers with the tube of the corolla split nearly or quite to its base on the upper side, while from the cleft thus formed the stamens project, their anthers being united to form a tube which is frequently bent downward at its extremity, while the style passes through its center.

To one interested in the devices by which nature causes cross-fertilization to be effected, a closer examination will reveal some additional facts. Nectar is so abundantly secreted, in sunshine, within the base of the filaments—which are there split to give access to it—that the basal part of the flower is often quite filled with it. The structure and development of the stamens and pistil are essentially as Prof. Todd has described them in the January number of the NATURALIST, but in addition to the shaking of the anthers he mentions, I think that there is sometimes another reason for the discharge of pollen on the back of an insect entering the flower. The style is in contact with the stamens only by its ring of collecting hairs, and a slight upward pressure on the tip of the anther tube would move the anthers backward without moving the style, and would thus imitate the action of a pump

[1] In the Ann. and Mag. of Nat. Hist., 1868, Vol. II, p. 260, is a very good description of the mode of fertilization of the "common blue" Lobelia. Hildebrand and H. Müller, in Germany, and Delpino, in Italy, have also described the fertilization of species of this genus; but as their writings are inaccessible to many American readers, it is thought that the following observations, made in the summer of 1878, at the Botanical Laboratory of Cornell University, may be of some interest. The insects were kindly named for me by Dr. Packard and Mr. Cresson.

in which the piston remains stationary while the barrel moves—pollen would be pumped out of the moving anther-tube by the stationary style with its ring of hairs. Moreover, when the staminate stage of the flower (lasting about three days in *L. erinus*) is ended, and the style protrudes from the orifice of the anthers, the hairs on the style become reflexed, thus apparently serving to prevent such pollen as is not infrequently left in the anther tube from falling out upon the papillose stigma when this is unfolded.

In *L. erinus*, and twelve out of fourteen other species, indigenous and foreign, which I examined, I found essentially the relations of corolla and stamens described by Prof. Todd; and in all cases, the lower lip of the corolla is provided at its base with two longitudinal ridges, including between them a guiding groove which leads into the tube of the corolla directly beneath the tip of the anthers (Fig. 1), thus forcing a bee to enter every flower in the same way. In the thirteen cases mentioned the two lobes of the upper lip of the corolla are nearly erect, as if to prevent an insect from creeping back on the tube of the corolla and obtaining nectar surreptitiously through the cleft on its upper side. The corolla-tube is also comparatively broad, and an open passage is left between its lower border and the filaments (Fig. 3), thus giving access to such insects as small bees, which creep bodily into the corolla in order to reach the nectar within its base.

In *L. cardinalis* (Fig. 4) and the Hawaiian *L. macrostachya* the lower lip of the corolla is pendant, and there is but a narrow passage between the corolla-tube and the stamens, which in these species are greatly elongated, with the tip of the anther-tube at a considerable distance from the corolla (Fig. 4). The two lobes of the upper lip of the latter are often horizontal or even deflexed, appearing to serve their purpose best when in these positions. The flowers go through the same dichogamy as the others, but they are adapted to profit by the visits of large Lepidoptera or even of humming birds, since a bee cannot enter the narrow and elongated tube of the corolla, while even if it could it would encounter the tip of the anthers or the protruded stigma only by the merest accident. On the other hand a hawk-moth or humming-bird could easily poise itself before the flower, and, while removing nectar by its long slender proboscis or bill, this would come in contact with the anthers or stigma, since the guiding-

groove of the corolla would force it to visit each flower in such a position as to secure this result.

I have repeatedly watched for hours plants of *L. erinus*, *L. inflata*, *L. kalmii* (Figs. 1 & 2) and *L. syphilitica*, growing in abundance near our laboratory; and on sunny days I have never failed to see them visited by many bees, though I have often watched isolated plants in vain. On *L. erinus* I have seen numerous individuals of *Augochlora pura* and several species of *Halictus*, and with the exception of one individual of the last-named species they always entered the corolla from the front, creeping in bodily if small enough, or forcing their heads in if they could not enter. I always found them well dusted with pollen. The exceptional individual of *Augochlora pura* was seen to visit eight or ten flow-

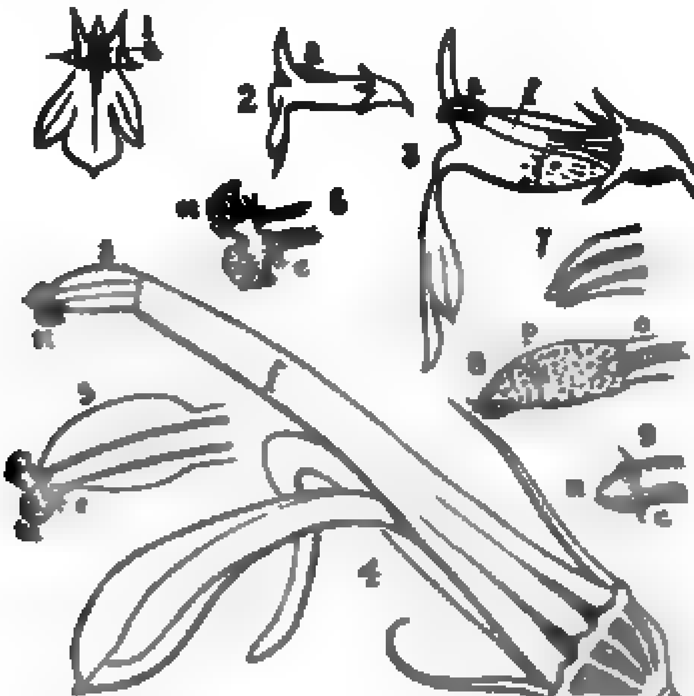

FIG. 1.—*Lobelia kalmii* from in front, slightly enlarged. FIG. 2.—The same from the side. FIG. 3.—Longitudinal section of the same, enlarged. FIG. 4.—Longitudinal section of *L. cardinalis* (X 2). FIG. 5.—Section of anther-tube of flower of *L. kalmii* in the second or pistillate stage, enlarged. FIG. 6.—Stigma of the same, enlarged. FIG. 7.—End of anther-tube of a flower in the first or staminate state, showing the hairs closing its mouth, enlarged. FIG. 8.—Section of the same, enlarged. FIG. 9.—Stigma of the same, enlarged. In all of the figures *a* indicates the anthers; *c*, collecting hairs; *f*, filaments; *p*, pollen; *st.*, stigma.

ers, and it always settled upon the tube of the corolla near its base, and inserted its proboscis through the cleft from which the stamens protrude, thus obtaining the nectar of the flowers without transferring their pollen. Other individuals of this species were seen to visit the flowers properly, and, although unable to creep well into the corolla, they forced their heads in far enough to

reach the nectar with their protruded tongues, and they always transferred pollen. On several occasions I saw small humble bees visit flowers of this species, attracted by their color from neighboring beds of verbenas which they often visited; and one of them when killed and examined under the microscope was found to have its proboscis dusted with oval pollen grains, not to be distinguished from those of this lobelia. For some reason I did not see a single hive-bee on these plants, although where they are abundant they are said to frequent these flowers in large numbers.[1] Twice I saw yellow butterflies (*Colias philodice*) visit these flowers, but though I carefully watched them as, poised on the corolla lip, they sipped the nectar, I could not see that they removed any pollen, their proboscides being slender enough to penetrate the tube without touching the anthers, still, pollen may be carried by them occasionally. On several occasions I saw specimens of a fly (*Calliphora vomitoria*) busily engaged at what appeared to be eating pollen, and their foreheads always came in contact with the anthers or stigma, from both of which, as well as the underlying surface of the corolla, they appeared to gather the pollen. Specimens of another fly (*Syritta pipiens*) were seen repeatedly on the lip of this flower, but I doubt if they were after pollen, and I never saw them come in contact with the anthers or stigma.[2]

On *L. inflata* I captured only *Augochlora pura* and a species of *Halictus*, but observed many individuals of these species, and believe that I saw at least two other species of quite similar size but very different appearance.

On *L. kalmii* specimens of *Augochlora pura* and two species of *Halictus* were taken.

Very many humble-bees of all sizes, and probably belonging to several species, were seen to visit flowers of *L. syphilitica*, behaving precisely as did the smaller bees on the species previously spoken of. Numerous small bees belonging to several species, chiefly of *Osmia* and *Ceratina*, were also seen to visit these flowers, but they were too small to brush the anthers. On one occasion I saw several individuals of *Ceratina dupla*, a small bee, enter the tube of the corolla, and afterwards retreat. Then,

[1] Darwin, Cross and Self Fertilization, American edition, p. 420.

[2] Hildebrand has described in the Botanische Zeitung, 1870, p. 638, cases in which the stigmas of this species could not escape from the anther-tube, and, expanding there, were self fertilized.

levating themselves, they were able to reach the end of the anther-tube, and from this or the protruded stigma they collected small quantities of pollen.

On several occasions I watched a few plants of *L. cardinalis* till twilight with no success, but as this species is not very plentiful in the swamps about Ithaca this is not to be wondered at. Once, however, after watching for several hours, I saw a single ruby-throated humming-bird visit the racemes of six or seven plants that I had collected and placed together in a pool of water within a few feet of the place where I sat. When sipping the nectar the bird balanced itself before the flower, and I could see that its bill always touched the anthers. Being necessarily at too great a distance to see whether there was pollen on its beak, I was obliged to rely upon the examination of a few stigmas, which, in anticipation of this difficulty, I had previously examined and marked. On one of these I found quite a number of pollen grains where previously I had found none. On others, on which pollen had previously been seen, there was plainly more. These cases show that pollen is thus carried, though apparently in small quantities. Though I saw no Lepidoptera visit this species, I see no reason why they should not do so, especially the *Sesias*, and if such be the case they will probably transfer pollen from flower to flower. Where many plants grow together a few observations early in the morning and in the evening will probably prove this to be the case.

To prove the almost self-evident fact that extraneous aid is needed to insure fertilization with the Lobelias, I carefully covered (with gauze nets supported by light frames) two plants each of *L. inflata* and *L. syphilitica*, on each of which I had artificially fertilized the only flowers then in the pistillate state. These flowers set fruit well filled with seed. One of the nets collapsed so as to be in contact with the plant, and several of the flowers of this plant set fruit; but in the two other cases, one of each species, none of the flowers not artificially fertilized produced seed, though their ovaries became more or less swollen. The fourth plant was not observed after being covered. Plants growing uncovered beside these, and others artificially fertilized from time to time and covered by similar nets, were fully fertile, showing that situation or enclosure did not cause this failure to fruit.[1]

[1] Darwin also states, Cross and Self Fertilization, p. 364, that *L. ramosa* and *L. fulgens* are quite sterile without insect aid.

As a rule, especially in plants like *L. syphilitica*, which are of simple habit, the flowers are visited by bees from the lowest one of the raceme upward, as has been observed by others to be the case with so many other plants. The humming-bird that I saw visiting *L. cardinalis* also acted in precisely the same way. As the lowest flowers are the oldest, and consequently the only ones in the pistillate stage of development, it is evident that they will usually be fertilized by pollen from a distinct plant, and after they are all fertilized, pollen is taken from flowers situated higher on the raceme for the fertilization of the older flowers of the next raceme visited. With the creeping *L. erinus* I have noticed that bees visit the flowers indifferently, alighting on almost any flower which protrudes from the tangle. But after once alighting they generally adhere to the branch on which this flower is situated, working upward upon it: though this is not invariably the case.

In many species, perhaps all, the style elongates sufficiently to cause the mature stigma to stand at a considerable distance without the anther-tube, thus making it still more certain that it will be brushed by an insect visiting the flower than is the case with the tip of the anthers, for a superabundance of pollen admits of an occasional failure to remove it, but it is imperatively necessary that each stigma be fertilized.

A CONTRIBUTION TO THE ZOÖLOGY OF MONTANA.

BY E. D. COPE.

THE Territory of Montana, taken as a whole, is probably the most valuable tract of land which has not yet been placed under control of a State government, within the limits of the United States. As is well known, the diminished elevation of the Rocky mountains and adjacent plains, as well as the northward bend of the isothermal lines, indicate for Montana a milder climate than that of the Territory of Wyoming on the south, and that of Dakota on the east. Its agricultural wealth is greater than that of either of those Territories, and it is superior to both in the yield of its mines. Timber abounds on its numerous mountain ranges, and it is, par excellence, the range of the large game of North America.

My acquaintance with this region was chiefly obtained through

an expedition which I undertook in the summer and autumn of the year 1876. I left Franklin, Utah, by the Helena stage, which carries its passengers through parts of Idaho and Montana, reaching Helena in four days from the time of starting. The route first traverses the rolling country of Bear river, and then enters the sandy lava desert of Eastern Idaho. Passing this inhospitable region, we cross the main range of the Rocky mountains and enter Montana by the Red Rock valley, which is watered by one of the creeks which form the heads of the Missouri. Here commence the beauties of Montana scenery. The numerous parallel ranges of low mountains are capped by masses of lava, the remnants of an ancient outflow that once covered the country. The faces of this rock are vertical, often approaching columnar, and generally possess a serrate crest. The slopes below them, and the lower valleys, are beautifully green. Before reaching Helena a portion of the granite region is passed over. Here the scenery is of a different character. The more yielding material of the rock has given the hills more rounded forms, and huge masses of weathered boulders, piled in the most grotesque manner, are often seen. The timber is more abundant, and the hills abound in game, especially grouse (*Tetrao obscurus*, etc.). On their sides several species of *Sciuridæ* are numerous.

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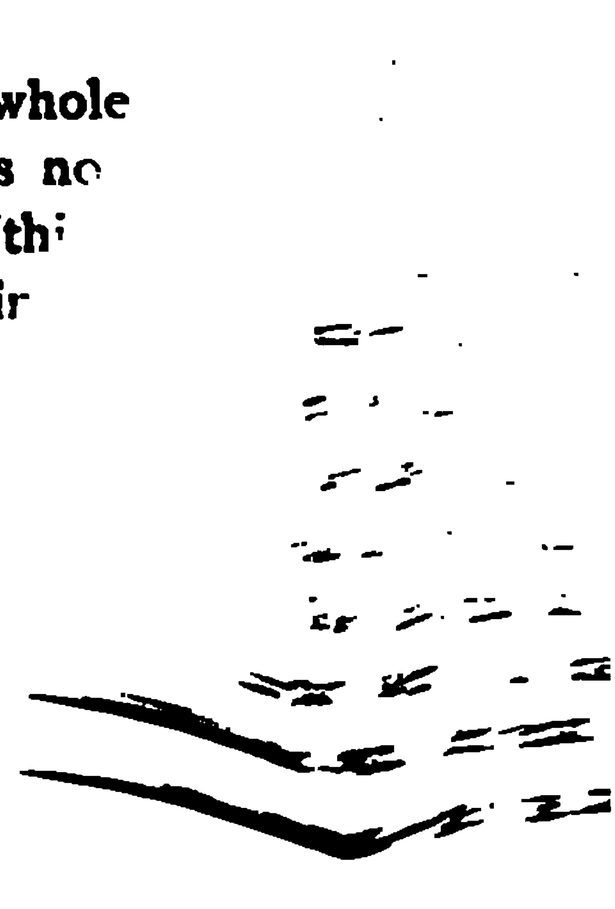

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Continuing beyond Helena to the north-east, the Palæozoic region is reached. The stage route for Fort Benton passes through the Prickly Pear canyon, a narrow pass of a thousand feet in depth, between great walls of carboniferous rocks. After issuing from it and crossing a high mountain, the stage descends to the plains. Previous to visiting this region, I had not realized the fact that the same plains with which I had become familiar in Kansas and Colorado, extended west and north of the Missouri river, with all their peculiar scenery and products; the buffalo grass, the prairie dog and antelope, the yelping coyote, the owls, the prairie rattlesnake and the herds of bison. At Fort Shaw the [illegible]rs grandly on the western horizon, and on [illegible]ins rise abruptly in magnificent propor-[illegible]n.

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As a rule, especially in plants like *L. syphilitica*, which are of simple habit, the flowers are visited by bees from the lowest one of the raceme upward, as has been observed by others to be the case with so many other plants. The humming-bird that I saw visiting *L. cardinalis* also acted in precisely the same way. As the lowest flowers are the oldest, and consequently the only ones in the pistillate stage of development, it is evident that they will usually be fertilized by pollen from a distinct plant, and after they are all fertilized, pollen is taken from flowers situated higher on the raceme for the fertilization of the older flowers of the next raceme visited. With the creeping *L. erinus* I have noticed that bees visit the flowers indifferently, alighting on almost any flower which protrudes from the tangle. But after once alighting they generally adhere to the branch on which this flower is situated, working upward upon it; though this is not invariably the case.

In many species, perhaps all, the style elongates sufficiently to cause the mature stigma to stand at a considerable distance without the anther-tube, thus making it still more certain that it will be brushed by an insect visiting the flower than is the case with the tip of the anthers, for a superabundance of pollen admits of an occasional failure to remove it, but it is imperatively necessary that each stigma be fertilized.

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A CONTRIBUTION TO THE ZOÖLOGY OF MONTANA.

BY E. D. COPE.

THE Territory of Montana, taken as a whole, is probably the most valuable tract of land which has not yet been placed under control of a State government, within the limits of the United States. As is well known, the diminished elevation of the Rocky mountains and adjacent plains, as well as the northward bend of the isothermal lines, indicate for Montana a milder climate than that of the Territory of Wyoming on the south, and that of Dakota on the east. Its agricultural wealth is greater than that of either of those Territories, and it is superior to both in the yield of its mines. Timber abounds on its numerous mountain ranges, and it is, par excellence, the ran[illegible] game of North America.

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an expedition which I undertook in the summer and autumn of the year 1876. I left Franklin, Utah, by the Helena stage, which carries its passengers through parts of Idaho and Montana, reaching Helena in four days from the time of starting. The route first traverses the rolling country of Bear river, and then enters the sandy lava desert of Eastern Idaho. Passing this inhospitable region, we cross the main range of the Rocky mountains and enter Montana by the Red Rock valley, which is watered by one of the creeks which form the heads of the Missouri. Here commence the beauties of Montana scenery. The numerous parallel ranges of low mountains are capped by masses of lava, the remnants of an ancient outflow that once covered the country. The faces of this rock are vertical, often approaching columnar, and generally possess a serrate crest. The slopes below them, and the lower valleys, are beautifully green. Before reaching Helena a portion of the granite region is passed over. Here the scenery is of a different character. The more yielding material of the rock has given the hills more rounded forms, and huge masses of weathered boulders, piled in the most grotesque manner, are often seen. The timber is more abundant, and the hills abound in game, especially grouse (*Tetrao obscurus*, etc.). On their sides several species of *Sciuridæ* are numerous.

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The road thence to Fort Benton is varied by ponds and "slews" whose proportions depend on the quantity of the rains. These are the homes of numerous Siredons, Speas and toads.

From Fort Benton eastward the Missouri flows between high

and often precipitous banks, and the elevated plain on the north side gives uninterrupted views of great beauty. To the north-east the red granite masses of the Bear's Paw mountains obstruct the view, and to the south, mountains of various outlines form the horizon. These are the Belt, Judith and Snowy ranges, and they enclose, with the bend of the Missouri river, an extensive plain. From this plain rise several table-topped masses, evidently remnants of old strata protected by an outflow of lava.

At the mouth of the Judith river the special object of my exploration began to claim attention, viz: the investigation of the beds of the Judith River Lignite formation and the extraction of their fossils. The results of this work are given in the Bulletin of the U. S. Geological Survey of the Territories, F. V. Hayden in charge, Vol. III, No. 3, 1877. The exploration included the valleys of the Judith river, Dog creek and Two Calf creek, and the canyons of the south side of the Missouri as far east as Amell's creek, and the corresponding situations on the north side of the river on the return to Fort Benton. These streams carve deep canyons through the yielding lacustrine and marine strata which underlie the plains, which often present scenery of terrible desolation and grandeur. The bluffs of the Missouri reach the height of one thousand feet in many places, and in but few localities are passable by wagons. The labyrinths of their branch canyons are only passable by pack animals, and the high land can only be successfully reached by a most careful discrimination of the main "divides," or water-sheds, from the innumerable spurs which diverge from them.

The plains of this region are neutral ground between the Crow and Sioux Indians, who are ever at war; and they have not been regarded as a safe abode for white settlers. The only Americans in the region are the few wood-choppers on the Missouri bottoms, and the freight and other agents of the Missouri river steamers and shipping houses, who for a few months of every year are stationed at Cow island. The country is practically left to the game, which is here generally unmolested excepting by occasional hunting bands of Indians.

While geological and palæontological exploration was the primary object of the expedition, a few zoölogical notes were taken, which I here record.

Mammals.—One of the characteristic mammalia of Montana

is the *Haplocerus montanus*, or Rocky mountain goat-antelope. It is not rare, and is said to be easily domesticated. The most southern and eastern locality at which I heard of its occurrence is the Prickly Pear canyon.

The abundance of game on the plains south of the Missouri is well illustrated by the experience of a day on which I rode from my camp to some bad lands which lay at a distance of perhaps ten miles from it. In the course of the ride I passed at least a dozen antelopes at different points, and the usual population of prairie marmots and several coyotes. On reaching the summit of a hill I came suddenly on four fine buck *Cervus macrotis*, and soon after descried a few bison grazing at no great distance. Passing a stream I surprised three does of the *Cervus macrotis*, and afterwards came upon the rather fresh trail of elk. On my return from the bluffs in the afternoon I encountered four grizzly bears together. They displayed considerable curiosity, and for some time seemed undecided as to the proper course to pursue; they advanced towards me one step and retreated two, and so alternately moving forward and backward they reached the edge of the rising ground upon which they stood; they then quickly disappeared behind it, and when they next came into view, were in full retreat some distance away.

Reptiles and Batrachians.—There was nothing noteworthy observed respecting reptiles. Not a tortoise was seen, and the only abundant snake was the *Crotalus confluentus*. This rattlesnake grows to its largest size in the Upper Missouri region, and is abundant in localities of different characters. The next most common reptile is the *Phrynosoma douglassi*, and after it the *Heterodon simus*.

Much more of interest was observed in the department of *Batrachia*.

Rana pretiosa Bd. and Gird. I found this species quite common in the Prickly Pear canyon and valley, associated with perhaps another and smaller species, which I did not succeed in taking. This west coast form is apparently confined to the damper mountainous regions, as I never met with it in any other part of the Rocky mountains, and it disappeared as soon as we entered on the plains. I observed a *Eutænia* in the same localities, but no Phrynosomas. The *Rana pretiosa* has shorter legs than the *R. aurora*, which with some varieties, can only be regarded as a subspecies of *R. temporaria*, so far as I can see.

Rana halecina berlandieri.—This abundant species replaces the preceding on the plains, and is the characteristic, and indeed the only *Rana* of the limited batrachian fauna of that widely extended district. On leaving the mountains this species immediately appears, accompanied by *Phrynosoma douglassi*, *Crotalus confluentus*, *Heterodon simus*, etc. The form which inhabits the plains differs in color and superior size from that found in the tide-water swamps of the Atlantic coast, on which account I have retained for it the sub-specific name at the head of the paragraph.

Spea bombifrons Cope.—This species is characteristic of the northern parts of the Plains and Great Basin. It was especially common in the region north of the Missouri river and eastward of Fort Benton. Before my arrival there, rain had fallen, and the ruts of the wagon trails were filled with water. These ditches contained numerous examples of this species, together with *Chorophilus triseriatus*, *Bufo dipternus* and *Amblystoma mavortium*. Their metamorphosis was completed by that time (August 20th), although some of the specimens were small.

In Idaho, near latitude 43° 30′, is situated a body of water known as Market lake. Its extent is variable, for it is said to be dependent for its water supply on the overflows of the Snake river, which is a few miles distant to the eastward. An old channel leads from the river to the lake, giving probability to the statement. At the time of my passage through the region, the water was unusually high, for a portion of the stage road with parts of numerous telegraph poles, was submerged. The lake appeared to be about ten miles long by six in width. The country surrounding it is arid, and the sand which represents soil, rests on a basis of lava. The stage halted for a short time to enable me to examine the shore of the lake. I found it to be lined with a wind-row of grasshoppers (*Caloptenus spretus*) which had fallen into the water and been washed up, some living, others dead. Among them I found numerous large fat larvæ of *Spea bombifrons*, occupying small spaces which they had cleared, quite out of the reach of the water. Their limbs were nearly fully grown, while their tails had suffered no absorption, and their jaws were toothless and cartilaginous; some quite larval in form, others with wider gape. They were engaged in eating the grasshoppers, and I detected several specimens with the entire insects in their mouths. In some instances the grasshoppers' bodies were too

large and projected from their mouths. These precocious larvæ were evidently air-breathers, and hopped about, presenting a curious appearance as they dragged their large tails after them. I found some adult specimens of *Amblystoma mavortium* also, along the waters edge. These observations were made on the 11th of August, 1876.

Chorophilus triseriatus Wied.—This widely distributed species I obtained at Franklin, on the Utah-Idaho boundary, and subsequently found it very common in the ruts of the wagon trails on the plains east of Fort Benton. In the latter locality it was generally of a bright green color.

Bufo dipternus Cope, sp. nov.—This toad I found abundant on the plains north of the Missouri river east of Fort Benton, in the wagon ruts of rain-water, in company with *Spea bombifrons*, etc. It is of about the same size as the latter species, and resembles it in various ways; it doubtless has similar fossorial habits, as it is furnished with a tarsal shovel of the same proportions, and has in addition a second tarsal bone produced into a digging spur. The prefontal bones are thickened in the same way, although not to the same extent as in *Spea bombifrons*, a condition, no doubt, directly connected with the habit of pushing aside the earth while excavating burrows with the feet. It is easily distinguishable from the Spea, by the ordinary collector, by its large dorsal spots, which are much better defined than are the small ones of the *S. bombifrons*. I did not find the *Bufo dipternus* south of the Missouri river; there its place is occupied by a very distinct species.

This *Bufo* differs from the *B. lentiginosus* and all its sub-species in the presence of two well-developed fossorial tarsal spurs, and in the large size of the internal one. In this respect it need only be compared with the *B. compactilis* Wiegm., from South Texas and Mexico. It is distinctly related to the latter, but is separable from it as a distinct species on account of (1) its much smaller size, reaching only half the dimensions, (2) the smaller size and obscurity of the tympanic membrane, which is only one-third the diameter of the eye-slit, while in *B. compactilis* it is one-half the same diameter, and is well defined, (3) the larger and truncate external tarsal spur, and (4) the coloration, which is quite distinct. The head in the adult *B. compactilis* is also distinctly shorter.

There are two faint straight supraorbital ridges, and a postorbital but no supratympanic ridge. The supraorbitals are united

by the enlargement of the posterior part of the prefontal bones, which forms quite a tuberosity. in adults. These bones slope steeply, truncating the muzzle obliquely in profile to the nares; the latter then descends vertically to the lip border. The sides of the muzzle are flat. The length of the head to the line of the postorbital ridges is just one-fourth of the length to the extremity of the coccygeal style; it enters the same axis of the *B. compactilis* five and one-half times. The parotoid glands are wide ovals and are in contact with the postorbital ridges as in *B. compactilis.* The choanæ are rather smaller than the nares. The skin is roughened with small tubercles above and below, those of the superior surfaces being larger and more spaced. When the hinder leg is extended forwards, the end of the astragalus reaches the tympanic membrane. The posterior digits are shortly webbed at the base. Their extremities, like the spurs, are capped with brown horn, but these sheaths are readily lost in spirits, and with them some of the characters of the species.

In life the color of this species is ashen, marked with three pairs of large brown spots on the back. A similar spot crosses each eyelid, and there is a pair on the end of the muzzle. There are two or three large longitudinal spots on the sides which may unite into two bands, one above the other. The spots have blackish edges and paler centers with yellow or red tips on the tubercles; the ground is brighter round the spots. The limbs have similar large spots on their superior surfaces, and the palms and soles are yellowish. There are two large spots below the eye, and smaller spots on the tips in front. Below immaculate.

Length of head and body, m. .040; do. of head, .010; width of head behind rictus ovis, .016; length of fore limb, .020; do. of hind limb from vent, .048; do. of hind foot, .022.

This species is one of the handsomest of the nearctic species of the genus.

Bufo ? sp.—I have already alluded to this toad as representing the *B. dipternus* on the south side of the Missouri river on the plains of Northern Montana. I saw numerous specimens on Dog creek, but was unfortunately unable to preserve them on account of the want of spirits. The species is small and resembles the *Spea bombifrons* in its color much more nearly than does the *B. dipternus*, since it exhibits numerous small spots without margins. But it does not have the developed tarsal spurs of the *B. dipternus*, and resembles much more nearly the *B. lentiginosus.* I am under the impression that it should be considered a subspecies of that widely distributed toad.

Amblystoma mavortium Baird.—I have already mentioned finding this species in rain pools north of the Missouri, and on the

shore of Market lake, Idaho. Twelve miles northward of the latter is a much smaller body of clear water which is more permanent in its character, since I was told when there that it had not been dry since 1871. On the shore I found several specimens of the *Amblystoma mavortium* in various stages of transition from the larval condition. They mostly presented stumps of the branchial processes, with a greater or less degree of atrophy of the fimbriæ. These animals occupied holes the size and shape of their bodies excavated vertically in the sand, from which their heads protruded. They were so situated as to be overflowed by every slight change of level of the water, which also kept their holes full. This situation is especially adapted to a state of transition from a branchial to a pulmonary respiration.

This is the only species of salamander I observed in Montana. Its abundance in the central district of the nearctic region is now well known, and a full account of its numerous transitional and color forms will be found in my monograph of the genus *Amblystoma*, published in 1867.[1]

Fishes.—The food fishes at Fort Benton are the *Lucioperca borea*, the *Scaphirhynchops platyrhynchus* (sturgeon) and the *Lota maculosa* (ling). Of these the *Lucioperca* is easily the superior, but the sturgeon is not a bad fish. The "chub" of the river at that point is the *Pogonichthys communis*, which sometimes grows to a foot in length, and is the usual bait for hooks. *Hyodon tergisus* is common there also. In the mountain streams at the heads of the Missouri and its tributaries the trout and white-fish (*Coregonus williamsonii*), are the universally prized pan fishes. I heard that the grayling (*Thymallus montanus*) occurs occasionally with them, but did not see it myself. The following is a list of the species which I observed in the Missouri river and its tributaries. Of course it is a mere contribution to the subject, as I did not fish extensively at any point. The larger number of species were taken at the lower part of the course of Battle creek, which empties into the west side of the Missouri not far north of the mouth of the Moreau, Dakota. At the season of the year (October) when I visited it, the creek was reduced to a chain of pools, which occupied hollows in the clay shales of Cretaceous No. 4. The alkaline substances from these shales saturated the water, but this did not prove fatal to very numerous specimens of eight species of fishes.

[1] Proceedings Academy Natural Sciences, Philadelphia, p. 166.

Percomorphi.—*Lucioperca borea* Richdn.—Abundant all along the river. The specimens agree very nearly with the description of *L. canadensis*, given by Jordan,[1] but I find six long pyloric cœca, two a little shorter than the others. The second dorsal rays number nineteen in three specimens, the last one split. Girard gives the number as twenty.

Lota maculosa Leseur.—Common; Battle creek.

Nematognathi.—*Ichthælurus punctatus* Raf.—Pools left by the river near Battle creek.

Plectospondyli.—*Semotilus corporalis* Mitch.—Battle creek.

Pogonichthys communis Gird.—Fort Benton, Judith river.

Rhinichthys maxillosus Cope.—Battle creek.

Phoxinus milnerianus Cope, sp. nov.—Form elongate; chin slightly beyond upper lip. Pharyngeal teeth 2.5–4.2. Scales in fifteen longitudinal rows between the dorsal and ventral fins. Diameter of orbit equal to length of muzzle, and entering length of head three and a-half times. The latter enters the length to the origin of the caudal fin four times. The greatest depth enters the same five and a-half times. The dorsal fin originates above a point behind the entire base of the ventral. Radii D. I. 8. A. I. 8. The mouth is rather large, the extremity of the maxillary bone extending nearly to the line of the pupil of the eye. The head is rather flat above and wide, the parietal width being about one-third the length between the last dorsal ray and the base of the caudal. The distance to which the lateral line extends is unknown because the scales of the posterior part of the body are lost.

Color brownish-olive above; below silvery. A black band, not well defined on the borders, extends from the end of the muzzle to the base of the caudal fin, where it terminates in a black spot. A reddish spot at the base of the anterior dorsal rays, muzzle dark. Length, m. 0.065.

This species differs from the *P. neogæus* Cope, in its slender form and small number of rows of scales. It is dedicated to my friend Jas. W. Milner, of the U. S. Fish Commission.

Chrosomus sp.—Small individuals from Battle creek.

Hybognathus evansi Girard.—This fish was very abundant at Battle creek. It has the slender suborbital bones of the *argyritis* group, with the small eye of the *nuchalis* group, and is a well marked species.

Hyborhynchus nigellus Cope.—From Battle creek; originally described from Colorado in the Report of Lieut. G. M. Wheeler.

[1] First Annual Report of the Ohio State Fish Comm., 1877, pp. 69–87.

I may here mention that the *Hyborhynchus siderius* Cope, is a *Hybognathus ;* its enumeration under the former head being the result of some one's inadvertence. The *Rhinichthys maxillosus* of that report I believe now to be distinct from the species I called by that name, and I propose that it be termed *R. transmontanus.* It differs from the more eastern species in having the dorsal fin equidistant between the base of the caudal and the end of the muzzle, and in having the longitudinal series of scales below the lateral line more numerous (12–13) and equal to the number of scales above it. In *R. maxillosus*, from Battle creek, they number $\frac{10-12}{7-9}$.

Isospondyli.—*Hyodon tergisus* Les.—Judith river and pools of the Missouri near Battle creek.

Coregonus williamsonii Gird.—Heads of the tributaries of the Upper Missouri.

Ginglymodi.—*Lepidosteus productus* Cope,[1] and *L. otarius* Cope.—I found both these species in pools left by the Missouri river near to Battle creek, maintaining their characters exactly. They differ in both proportions and color. The *L. productus* is lead colored above and white below, the colors gradually commingling on the sides. There are no spots on the sides nor at the base of the tail, and there are three spots on the caudal fin. In *L. otarius* of the same small size, the darker lead color of the back is abruptly separated from the white of the belly by a row of dark spots, and there is a black spot at the base of the caudal fin. The spots on the latter are large and more numerous.

The specimens I obtained of both species are young. One of the *L. productus*, of eight and one-half inches in length, exhibits the persistent caudal *chorda dorsalis* with dermal margin, which has been observed by Prof. Wilder. It is nearly absorbed in a rather larger example.

Chrondrostei.—*Scaphirhynchops platyrhynchus* Raf.—Abundant in the Missouri. An individual taken at Fort Benton weighed forty-seven pounds. I secured its head.

[1] Proceed. Academy, Philadelphia, 1865, p. 86.

RECENT LITERATURE.

A JOURNAL OF A TOUR IN MAROCCO AND THE GREAT ATLAS.[1]—Naturalists, and especially botanists, cannot soon forget the delight with which they perused the volumes of the Himalaya Journals. Indeed there is a grace of style, a closeness of observation and an accuracy of statement in Sir Joseph Hooker's writings which claim the attention and interest even of the general reader. His account of his journey to Marocco, in 1871, has been anticipated with delight by all readers of his former travels, nor will they be disappointed when they take up the volume before us.

Owing to Sir Joseph Hooker's pressing engagements as Director of Kew Gardens and President of the Royal Society, there has been unavoidable delay in the publication of the journal; indeed, at his own request, Mr. John Ball, who accompanied him in the journey, completed the work after the first two chapters. No one, however, will regret this, for Mr. Ball is certainly a good writer and close observer, not hesitating to relieve his narrative now and then by humorous comments on men and things. It is stated by the authors that owing to the peculiar condition of Marocco (which it will be observed they spell with an *a*) no great change has probably occurred in that country since their visit, and hence the delay in publication is of less consequence than would usually be the case.

"The narrative now published is mainly founded on the journals kept by Sir J. Hooker and Mr. Ball, supplemented in some particulars by that of their fellow traveler, Mr. G. Maw."

The desire of the distinguished party was to penetrate the Atlas range and to determine some vexed points of geography while collecting the plants of this almost unknown region. Although provided with the order of the Sultan to allow them all possible privileges, they were constantly thwarted in their desires by the fanaticism and suspicions of local governors and petty chiefs. The Sultan's letter, it is true, did not appear to give very explicit directions, and to the mind of the reader, at least, leaves that sovereign open to the suspicion of chicanery: "On receiving this, you will send the English hakeem and his companions to the care of my slave, El Graoni, to whom I have sent orders what he is to do." Judging from after developments, the slave, who was a powerful chief, read freely between the lines. The party succeeded, however, on one occasion, in escaping from the surveillance of the guides and actually reaching the much-coveted snow. We quote the graphic account of this ascent:

"Much to our satisfaction the sheik now withdrew, committing us to the charge of an active but unarmed young Shelluh, with

[1] *Journal of a Tour in Marocco and the Great Atlas.* By Sir J. D. HOOKER and JOHN BALL. London, Macmillan & Co., 1878. $6.50.

strict injunctions to lead us as far as the snow, but not to allow us to proceed farther. It is hard to say whether the sheik and his people felt any real uneasiness as to the possibility of a casual encounter with natives of the Sous valley; but it was pretty clear that they had succeeded in frightening our attendants, as our Mogador men, usually so active and attentive, soon dropped behind and were not again seen till our return in the afternoon. We took the most direct course in the ascent, following a slight gully down which flowed a mere trickling rivulet, fed by the snows on the upper slope of the mountain, and pushed on rather fast with a view to get as high on the mountain as possible before the sun reached the meridian.

"Bearing in mind the great diversity in the vegetable population which is seen in Southern Spain (the high mountain region nearest to the great Atlas), where neighboring peaks of different mineral structure exhibit numerous quite distinct species, and very few identical features, and having found the flora of the lower valley to a great extent different from that of Aït Mesan, we confidently reckoned on obtaining still greater evidence of distinctness in that of the upper region. It was, therefore, with some surprise that, as we continued the ascent, we met, one after another, many of the peculiar species that we had first seen in the ascent from Arround to the Tagherot pass, and comparatively few not already familiar to us. For once, however, it must be owned that during part of this day, our emotions as botanists yielded to the interest that we felt in the near prospect of a peep into *terra incognita*. If but little had hitherto been known of the northern slopes of the Great Atlas from the reports of the few travelers who had viewed the range from the low country, or had attained its outer slopes, the southern side of the main chain remained a sealed book to the geographers, whose reliance on the vague reports of native informants has led them, like the chartographers of the middle ages, to fill up the blank space on their maps by representations utterly discordant and contradictory. * * Of the physical features of the country we could learn nothing.

"By the time we reached the lower skirts of a long snow slope that stretched upwards towards the summit of the mountain, the sun, which had now ascended nearly to the zenith, beat down upon us with intense rays, that drove some of the party to seek temporary shelter. The guide probably considering that he had done his day's work, and finding a narrow rim of shadow under an overhanging rock, lay down with his head screened from the blazing heat. Ball, who was suffering from a violent headache, also found a spot that gave partial shade. Hooker took advantage of the halt to push on at a steady pace that soon carried him beyond the reach of interference from the guide. When Ball felt able to resume the ascent, the guide sprung to his feet, and

for the first time became aware that one of the party was already too far ahead to be easily overtaken. He proceeded, by a series of unearthly yells and frantic gesticulations, to attempt to attract Hooker's attention, and urge him to return. When these demonstrations were found to be useless, and he perceived that Ball was also about to follow in the ascent, he commenced a fresh series of exclamations and pantomimic gestures, of which the burden seemed to be that if we went we were certain to be shot; but the same argument that was used with effect on the Tagherot pass—the gift of a silver coin—was so far successful that no attempt was made to arrest Ball's progress, and after ascending a few hundred feet higher, the unwilling guide gave up the attempt, and rested comfortably until he had an opportunity of rejoining Hooker in his descent. * * *

"Hooker reached the summit about 2 P. M., and was rejoined by Ball nearly half an hour later. Excepting some light fleecy cumuli floating over the low country to the north, at a lower level than the eye, the sky was cloudless; but in some directions a thin haze obscured the details of the vast panorama. Our first glance was inevitably directed towards the unknown region to the south, and there, at a distance of fifty or sixty miles, rose the range of Anti-Atlas, showing a wavy outline, with rounded summits, and no apparent deep depression, rising, as we estimated, to a height of from 9000 to 10,000 feet above the sea."

Full as the work is with graphic pictures, it is to the botanist, of course, that it will afford the most delight. Not only are plants described, but their habits and distribution are noted, as for instance when the authors speak of *Periploca græca* and *P. lævigata*. The latter is the single mainly western species, "This appears to be common in the Canary islands, and grows freely in the tract now visited by us to the north-west of Mogador. It has been found in abundance on some rocky islands near the coast of Sicily; but in spite of the silky hairs attached to the seeds, it has not spread itself to neighboring islands, nor to the Sicilian coast. It has been detected in two or three places in the south-east of Spain, and here and there in rocky places on the skirts of the desert in the interior of Algeria and Tunis. Finally, it was long ago found by Labillardière in one place on the coast of Syria. All this points to the former wide diffusion of a plant which no longer finds favorable conditions of existence, unless, perhaps, in the Canary islands. Its presence in the interior of North Africa may possibly date from the period when it grew near the coast of a great gulf opening to the Atlantic; but it is not easy to understand how it has held its ground in a climate so different from that of its natural home. This plant has inherited from a remote ancestor a habit which is now of no service to it. The young branches near the root twine round any adjacent support, but as they grow older they become stiff and straight, and

the taller specimens derive no adventitious support from this source."

A copious appendix at the end of the volume, which, by the way, is neatly illustrated, embodies, together with much other matter, valuable notes on the flora of Morocco and the Canaries, together with meteorological and geological information in a condensed form. We take pleasure in commending the work to our readers, feeling sure that it will meet with their approval.—*W. W. B.*

THE SERIES OF ANIMAL FORMS IN GEOLOGICAL TIME.[1]—In this work Prof. Gaudry brings together from his stores of palæontological knowledge the evidences of serial relation in time presented by various groups of *Mammalia*. Following in the steps of Kowalevsky (Palæontographica, 1873) and Cope (Journal Philadelphia Academy Sciences, 1874), he takes up the history of each portion of the skeleton separately, and although he does not exhaust the subject, he treats it more fully than either of the authors named. The volume is divided in correspondence to the orders of *Mammalia*, and in each division the characters of the skull and skeleton, of the feet and of the teeth are taken up successively. Prof. Gaudry's classification, it must be admitted, is somewhat antiquated, for he adopts the "orders" *Pachydermata* and *Solipeda*, including in the former the hogs. Under the *Marsupialia* he describes the interesting French genera of the *Creodonta*, giving excellent figures of their teeth, which are very welcome. He does not appear to have been acquainted with the researches of Cope on these animals published in 1875[2] in which it was shown that they cannot be referred with any probability to the marsupials. Under the head of *Pachydermata* an interesting discussion of the origin of the present dental type of the *Rhinoceridæ* is found, that part relating to the outer crests of the molars being apparently new. The portion relating to *Palæotherium* and *Lophiodon* is especially useful. Prof. Gaudry treats the *Amblypoda* lightly, the principal expositions of the characters of the order by American palæontologists not having probably come into his hands at the time of writing his book. The discussion of the teeth and feet of *Ruminantia* is especially full, and good figures of the parts of several genera little known in America are given. One of the best chapters is that on the *Carnivora*, where the gradations in the dental characteristics of the genera are clearly shown. The extinct *Quadrumana* of Europe are very well illustrated, including the genera of *Mesodonta*, found in France. The author admits the suggestion of Filhol, that the latter "presentent, comme les *Adapis*, des passages entre les lémuriens et les pachydermes" (p. 230); a position which we

[1] *Les Enchainements du Monde Animal dans les Temps Geologiques. Mammifers Tertiaires.* Par ALBERT GAUDRY. Paris, Savy, 1878. 8vo.
[2] Proceedings Academy of Natural Sciences, Philadelphia, December.

think is quite indefensible. In this chapter Prof. Gaudry discusses the flints found by the Abbé Bourgeois in the Middle Miocene (Calcaires de Beauce) of Loir-et-Cher, concerning which opinions so differ. They are regarded as works of art by many archæologists, among whom are cited MM. de Vibraye, de Mortillet, de Quatrefages, Hamy, etc., and the figures given by Prof. Gaudry are certainly favorable to this view. The great antiquity of the horizon is opposed to the belief that they could be the work of human hands, for the Calcaires de Beauce represent a horizon not much above the Oregon beds of our White river formation. As Gaudry remarks, no species of Mammal of that period still exists; and he adds, "it is not probable that the cutters of those flints remained the same amid universal change." His concluding words are as follows: "If then it is to be shown that the flints of the Calcaire de Beauce, collected by the Abbé Bourgeois have been cut, the idea which presents itself most naturally to my mind is, that they were fashioned by the *Dryopithecus*."

As a popular and at the same time scientific exposition of the succession of Mammalian forms, as displayed by their structural details, this book has no rival. The author has been led, like most other thorough students, to adopt the doctrine of evolution, and some of his reasons are here clearly set forth. The work is distinguished for the excellence of its engravings and typography.

RYDER ON THE MECHANICAL GENESIS OF TOOTH FORMS.[1]—In the several articles relating to this subject Mr. Ryder has made a valuable contribution to the doctrine of evolution. He adopts the classification of teeth proposed by Cope, and endeavors to explain by mechanical laws the succession or phylogeny of the various existing dental types pointed out by the same author. The application of mechanical theory to this question is ingenious, and results in some very probable hypotheses. First among these is the supposed effect of lateral pressure in flattening conical cones or cusps so that their section becomes semicircular or crescentic. Another is the probable crowding of tubercles on each other by impact transverse to their direction, producing plicate structure. His conclusions may be stated more in detail, and are as follows:

1st. That in *Carnivora* and *Omnivora* the jaws were simply opened and closed during mastication without lateral movement of the mandible or lower jaw, and that the earliest and most constant type of tooth accompanied this movement; that is, that the tubercles or cusps composing the teeth do not to any extent depart from the short-rooted type with conical tubercles, styled by odontologists bunodont. That the distance apart of the series of molars of opposite sides, of both upper and lower series, was

[1] *On the Mechanical Genesis of Tooth Forms.* By JOHN A. RYDER. Proceedings of the Academy Natural Sciences, Philadelphia, 1878, p. 45. Further notes on do. Loc. cit., 1879, p. 47.

approximately alike; that is, that in closing the jaws the external or buccal cusps of the upper series were brought exactly upon a line with those of the lower, not over them, as is the case in all *Herbivora* and to some extent in man. This condition he has called isognathism.

2d. That in the *Herbivora* the jaws were opened and closed in mastication with extensive lateral movement of the mandible; and that the teeth were by this greatly modified in respect of their tubercular constitution, the tubercles being of the type known as crescentic, giving us the long-rooted selenodont type of tooth. That in these the width of the jaw, or the distance apart of the upper series of molars of opposite sides of the head, greatly exceeds the same measurement in the mandible, which results in the external or buccal cusps of the upper series closing over and external to the buccal cusps of the lower series. This condition he has styled anisognathism.

3d. That in some *Rodentia and Proboscidea* the mandibles were moved in a backward and forward, or antero-posterior direction, which he has termed the reciprocating movement, with which there was also a corresponding tubercular modification, which he calls trichecodont—three tubercles forming transverse ridges, frequently obsolete, or greatly flattened transverse lamellæ, composed of elongated and united tubercles soldered together by a thick cementum layer. (Elephas). Isognathism is usually a characteristic of this subdivision.

4th. That in a subdivision including a part of *Rodentia* and *Proboscidea* (mastodon), the movement of the mandible was both reciprocating and lateral, with a still more complex type of dentition as a result, which he has styled ptychodont—enamel fluted and folded upon itself longitudinally and transversely. These jaws are usually anisognathous.

These observations, based upon investigations made not only upon the skulls but also upon the living animals, afford, he thinks, the key whereby to correctly interpret the morphological history of the teeth of the higher groups, especially when brought to bear on the interpretation of the teeth of the great number of herbivorous remains which the rocks have yielded in recent times as intermediate or antecedent forms.

The number of kinds of excursions made by the mandibular rami is limited by structural impediments, since a bar fixed at one end and free at the other, to which the mandible may be compared, is capable of but a few distinct movements. We find these to be essentially those mentioned in the definition of the four groups; few others are possible or conceivable. The first movement is the vibratory one in a vertical plane; the second is the vibratory movement in both the horizontal and vertical planes; the third is the vibration of the rami in an approximately horizontal plane, neither lateral nor vertical, but an antero-posterior

or reciprocating movement, parallel to the medial axis or line; the fourth is that which combines to a great extent the second and third. It is also to be observed that the lines described in most cases are not straight, but only approximately so, they being more or less curvilinear. With these four distinct types of mandibular movement there are as many distinct types of tooth-modifications, to which almost all the forms of teeth of Mammalia yet known may be referred. The bunodont type is that characteristic of group 1, and in which the tubercles have not been modified, because there have been no movements of a proper kind to produce the modifications in the enamel foldings as observed in the longitudinally or the transversely folded enamel crowns of the lophodonts (ridge or hill tooth). To this foregoing group 1 belong also all the haplodont type (simplest form) as observed in the toothed whales.

According to the doctrine of mechanical dental differentiation, the foldings of the enamel in the teeth of groups 2, 3 and 4, whether they be longitudinal or transverse, are due either to the lateral or reciprocating movement of the jaws. The sub-group, selenodonts—so called in consequence of the crescent-shaped foldings of the enamel of which the deer is a familiar example—is perhaps the most striking illustration of all. The characteristic crescent-shaped tubercles, the author thinks, have probably been evolved by a very slow process of flattening and bending outwards or inwards of the cornu of the tubercles, due to the strains exerted in masticating the tough woody food. The movement in this case being constantly in one direction, makes it still more probable that such has been the history of the process.

The incisors of many animals having been lost or hypertrophied either from the assumptions of their functions by other parts, as the lips, tongue or trunk, or by substitution of another function, as in the case of the tusks of the Proboscidians, it would seem that mechanical resistance has much to do with their special development, as is also seen in Rodents.

A summary of the foregoing views the author has stated as follows:

"1. That the earliest and simplest type of mammalian jaw-movement was that in which the mouth was simply opened and closed, without mandibular excursion, and co-existent with the simple haplodont or bunodont molar.

"2. That the development of the various kinds of excursive mandibular movement has apparently been progressive.

"3. That as the excursive movements have increased in complexity, there has been an apparent increase in the complexity of the enamel foldings, ridges and crests.

"4. From the fact that the foldings, etc., have apparently been modified in conformity to the ways in which the force used in mastication was exerted, it is concluded that the various modes

of crest and tubercular modification are related as effects to the diverse modes of mandibular movement.

"5. It is apparent from the facts presented throughout the context that the mandibular articulations, and correlatively the skull have probably been modified in shape by the movements made by the jaws and the forces exerted in executing them.

"6. From the fact that the incisor teeth are partially or entirely absent, or relegated to another function, in forms which have long prehensile tongues, mobile, prehensile lip or proboscides, it is held to be probable that such disappearance of the incisive dental elements is due to the assumption of their function by the prehensile organs indicated."

The bearing of these conclusions on the general doctrine of evolution is clear enough. The author of the papers reviewed has endeavored, and we think with much success, to solve in this field, the real question in hand, which is not so much the "survival of the fittest" (Darwinism), as the *origin of the fittest.* In so doing he has found it necessary to avail himself of the hypothesis of "acceleration and retardation," and of "use and effort;" views which have often found advocacy in the pages of this journal. We think that Mr. Ryder has supplied an important link in the chain of evidence which connects motion[1] as a cause, with structure as an effect, and we shall anticipate for him future success in this fertile field of inquiry.

Recent Books and Pamphlets.—Boletin de la Sociedad de Geografia y Estadistica de la República Mexicana. Tercera época, Tomo IV, correspondiente al año de 1878. Nos. 4 and 5. Mexico, 1879. From the society.

A Contribution to the Geology of the Lower Amazonas. By Orville A. Derby. (Ext. from the Proc. Amer. Phil. Soc.) 8vo, pp. 23. Philadelphia, 1879. From the author.

Découverte d'un Silicate Gélatineux Naturel. Par E. Renevier. (Bull. Soc. Vaud. Sc. Nat. XVI, 81.) 8vo, pp. 5. From the author.

Partie culminante de l'Ancienne Moraine Frontale du Glacier du Rhone sur les Flancs du Jura. Par E. Renevier. (Bull. Soc. Vaud. Sc. Nat. XVI, 81.) 8vo, pp 5. From the author.

Description de l'Ovule des Environs de Bruxelles. Ovula (Strombus) gigantea, Münst. Par Th. Lefévre. 8vo, pp. 35, plates 6. Bruxelles. From the author.

Neue oder wenig bekannte Reptilien beschrieben von Dr. J. G. Fischer. 8vo, pp. 27. Hamburg, 1879. From the author.

Mémoire l'homme prehistorique dans la Plata. Par Florentino Ameghino. (Revue D'Anthropologie.) 8vo, pp. 39. Paris. From the author.

Remarks upon the Kaskaskia Group and Descriptions of New Species of Fossils from Pulaski county, Kentucky. By S. A. Miller. 8vo, pp. 12, 1 plate. From the author.

Transactions of the Kansas Academy of Science for 1877 and 1878, Vol. 6. 8vo pp. 94. Topeka, 1878. From the Academy.

Notice of Gaston de Saporta's work: The Plants of the World before the Advent of Man. By Leo Lesquereux. (From Amer. Jour. Sci. and Arts, Vol. XVII, April, 1879.) 8vo, pp. 13, 1879. From the author.

Le Gypse des Environs de Menaggio (Lac de Como) Rectification à la carte géol-

[1] See this journal, January, 1878.

ogique de Spreafico. Par E. Renevier. (Bull. Soc. Vaud. Sc. Nat.) 8vo, pp. 9, 1879. From the author.

La Musée géologique de Lausanne en 1878. (Bull. Soc. Vaud. Sc. Nat. XVI, 81.) Par. E. Renevier. 8vo, pp. 15. From the author.

On the Structure and Development of the Skull in the Common Snake (Tropidonotus natrix). By W. Kitchen Parker. (From Phil. Trans. Royal Soc., part 2, 1878.) 4to, pp. 37, pl. 7. From the author.

Zur Fisch-Fauna des Magdalenen-Stromes. Von Dr. Franz Steindachner. 4to, pp. 62, pl. 15. Wien, 1878. From the author.

Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs. Fortgesetzt von Dr. C. G. Giebel. Sechster Band v. Abtheilung Säugethiere: Mammalia 21 u. 22. Lieferung, Leipzig und Heidelberg, 1879.

A Memoir of Joseph Henry. A Sketch of his scientific work. By William B. Taylor. (Read before the Philos. Soc. of Washington, Oct. 26, 1878.) Philadelphia, 1879. 8vo, pp. 140.

Museum Pests observed in the Entomological Collection at Cambridge. By Dr. H. A. Hagen. 8vo, pp. 7. Some Remarks on White Ants. By Dr. H. A. Hagen. 8vo, pp. 4.

On Larvæ of Insects discharged through the Urethra. By Dr. H. A. Hagen. 8vo, pp. 11. (From the Proc. of the Boston Soc. of Natural History.) 1879.

In the Matter of certain badly-treated Mollusks. By Robert E. C. Stearns. (Read before the California Acad. of Sciences, April 21, 1879.) 8vo, pp. 10.

Ituna und Thyridia. Ein merkwürdiges Beispiel von Mimicry bei Schmetterlingen. Von Fritz Müller. (From Kosmos.) 8vo, pp. 9.

Insects from the Tertiary Beds of the Nicola and Similkameen rivers, British Columbia. By Samuel H. Scudder. (From the Report of Progress, 1877–78. Geological Survey of Canada.) 8vo, pp. 11.

Annual Report upon Explorations and Surveys in the Department of the Missouri. By E. H. Ruffner, 1st Lt. Engineers U.S.A. Washington, 1878. 8vo, pp. 118.

Report on the present state of our knowledge of the Crustacea. Part IV. On Development. By C. Spence Bate. (From the Report of the British Assoc. Adv. Science for 1878.) 8vo, pp. 16.

On the Willemœsia group of Crustacea. By C. Spence Bate. (From the Annals and Magazine of Natural History, Dec., 1878.) 8vo, pp. 6.

Our Rush Light. 8vo. Issued by the Atco (N. J.) Natural Science Society, May, 1879.

Pennsylvania Geological Survey, Appendix P. Coal Flora Atlas. By Leo Lesquereux.

Etudes sur l'Embryogenie des Ephemeres notamment Palingenia virgo. Par Dr. W. Joly. Paris, 1876.

Contributions a l'histoire naturelle et a l'anatomie des Ephemeriens. Par Dr. N. Joly et E. Joly. Montpellier, 1876.

Nouvelles Recherches sur Prosopistoma. Par Drs. N. et E. Joly. Montpellier, 1876.

Descripcion Metamorfosis y costumbres de Una Especie Nueva del generò Siredon. Por José M. Velasco. Mexico, 1878 (? 1879).

Les Reptiles de l'Epoque Permienne aux Environs d'Autun, par Albert Gaudry. (Ext. Soc. Geol. de France, Dec., 1878.) 1879.

Description de deux Solens nouveaux par Lefèvre et Watelet. Bruxelles. No date.

Etude sur le genre Notidanus par E. Delfortrie. Soc. Linn. de Bordeaux, 1878.

Les Dunes Littorales de Golfe de Gascogne. Par M. E. Delfortrie. Soc. Linn. de Bordeaux, 1879.

GENERAL NOTES.

BOTANY.

THE MUTUAL RELATIONS BETWEEN FLOWERS AND THE INSECTS WHICH SERVE TO CROSS THEM.[1]—In 112 well illustrated octavo pages Dr. Müller has given us a very pleasantly-written account of the present state of our knowledge in this department of biology. Many of the facts and theories are by no means new, but many others appear in print here for the first time.

The writer shows that botany and zoölogy are more than mere "descriptive natural sciences" as they are even yet called, and that not the least of the good resulting from the theory of natural selection, advanced by Darwin, is the revival of an interest in biological studies—an interest which, excited a century ago by Réaumur, Roesel and Sprengel, had been entirely lost in the passion for systematic work which Linnæus inspired in his followers. Beginning with a description of the parts of a flower and their ordinary functions, he shows us how reproduction, the chief object of the flower, is accomplished, how the infinite variety of floral forms is produced from changes in the five fundamental organs of the flower—the calyx, corolla, stamens, ovary and nectar glands; how cross-fertilization tends to strengthen a series of descendants, and self-fertilization to weaken them; and how natural selection must preserve the former and render permanent such qualities as tend to secure crossing, while the latter will, in time, give place to them.[2] The probable course of development, from the lowest forms of life of those plants which are merely cellular, as the Algæ, mosses and liverworts, and still further of the vascular cryptogams and phænogams is well traced.

As regards their means of fertilization, plants are divided into two groups:

a. Gymnogamæ, including all plants which possess naked male cells capable of independent motion through the water to the female cell. This group contains all the sexual cryptogams, and is but slightly discussed by Dr. Müller.

b. Angiogamæ, including plants whose male cells are enclosed in a protecting cell wall, and are carried to the female cell by foreign agency. With this group, containing all the Phænogams, the present paper is chiefly concerned.

As agents for transferring the male cells or pollen of the Angiogamæ, we find water, wind, and various animals, as is

[1] *Die Wechselbeziehungen zwischen den Blumen und den ihre Kreuzung vermitteluden Insekten.* H. MULLER in Schenk's Handbuch der Botanik.

[2] It may be well to refer such readers as are interested in the discussion of this subject to an article by Rev. Geo. Henslow, in the *Popular Science Review* for January, 1879, where the figures by which Mr. Darwin proves the value of cross-fertilization, in his book on that subject, are made to show that after the first few generations there is a constant tendency towards equality between crossed and self-fertilized offspring, and where many instances of constant self-fertilization are collected.

well expressed in the terms *Hydrophilæ* (water-loving), *Anemophilæ* (wind-loving), and *Zoidiophilæ* (animal-loving), often applied to the different groups of Phænogams, according to the agency by which they are fertilized. Of the Hydrophilæ cur common *Vallisneria spiralis* may serve as an example. The Anemophilæ may be subdivided into *Archispermæ* and *Metaspermæ*, represented respectively by the pine and the oak, the former possessing naked ovules and winged pollen-grains, the latter, ovules enclosed in a pistil and wingless pollen; and, as indicated by the names, there is much reason to believe that the former represent an earlier stage in the development of plants than the latter. The Zoidiophilæ are divided into three groups, *Malacophilæ*, fertilized by snails, *Entomophilæ*, fertilized by insects, and *Ornithophilæ*, fertilized by birds. The first and last are represented by comparatively few species, by far the greatest number being entomophilous.

The writer gives a brief but clear account of cleistogamy and heterogymy, which Mr. Darwin has so well treated in his work on Different Forms of Flowers in Plants of the same Species, and gives many illustrations of the adaptation of certain flowers to the visits of certain groups of insects, as outlined in the NATURALIST for April, and of the various contrivances by which insects are enabled to obtain food from flowers of different forms. One of the most interesting of these is that of a Brazilian species of *Nemognatha* (a beetle), the maxillæ of which are developed to a length of twelve mm., exceeding the length of the insect's body and resembling the similarly-formed proboscis of butterflies. Very interesting, too, is the tongue of one of the higher bees, for when a bee is sucking nectar from a flower the fluid must necessarily rise the entire length of the tongue before reaching the organs of taste, and were it sucked up and then found unsatisfactory that which remains adhering to the whorls of hairs with which the tongue is provided would contaminate the nectar of the next flower visited, or at least destroy its proper taste. To avoid this difficulty the tongue of the higher bees is provided with a capillary tube in place of the chitinous rod found in that of the lower bees, and this communicates at its base with the taste organs, and opens into a spoon-shaped enlargement at the distal end of the tongue. On visiting a flower the bee thrusts this spoon-shaped organ into the nectar, and a portion immediately rises through the tube by capillary attraction, but if not of pleasing taste it is readily expelled before any has become entangled in the hairs surrounding the tongue.

The paper is, throughout, one of exceeding interest, and it is to be wished that every student of biology, and especially every young student, might read it.—*Wm. Trelease.*

BOTANICAL NEWS.—In the *Bulletin* of the Torrey Botanical Club for April, C. F. Austin, in notes on Hepaticology, describes

new liverworts from Florida, South Carolina and California, and several new exotic species. Prof. Eaton continues his notes on new or little known ferns of the United States.——Trimen's *Journal of Botany*, for May, contains A. W. Bennett's Polygalæ Americanæ novæ vel parum cognitæ.——Among other articles in Caruel's *New Italian Botanical Journal*, is one by F. Sestini on the action of the vapor of different substances in the seed during germination.——Three eminent botanists have recently died, Prof. G. L. Reichenbach, of Dresden, aged 86; Dr. F. M. Ascherson, at Berlin, aged 81; also Prof. Griesebach, who died at Göttingen, May 13th.

ZOÖLOGY.[1]

STRANGE HABITAT OF A BARNACLE ON A GAR PIKE.—I have recently received a barnacle from Mr. Jos. Wilcox, of Philadelphia, which he obtained from the scales of a gar in Hernando county, Florida. The specimens are small; the largest measures eight millimeters in carino-rostral diameter, about seven mm. in the other, the smaller specimen seven mm. in the first, and six mm. in the other direction. As nearly as I can make out, it is very near if not identical with *Platylepas decorata* Darw., though this species seems hitherto to have been recorded as coming from the Pacific only; the Florida locality is of considerable interest, therefore, as extending the range of the species. The fish from which the specimens were obtained was found in brackish water, and therefore agreeing in the nature of its habitat with the probable conditions of the water in the Gambia river, Africa, where the *P. bissexlobata* has been found on the manatee. There are no pores in the parietes, the midribs of the compartments were well developed, and in one specimen the membranous basis was as convex as the shell, in the other not quite as convex. The basal membrane seems to be reflected up over the parietes to near the aperture and also to extend some way outwards from the attached margin of the compartments, as if to afford a more extensive attachment to the fish.

I have been unable to find any record of the occurrence of these and kindred forms on the gar, but it would be well adapted to them, as their scales would afford secure attachment.

It would be of interest to know whether the creature's shell left a depression in the scales of the fish equal to the convexity of the basal membrane. Mr. Darwin observes in regard to other barnacles which attach themselves to turtles, whales and sharks, in effect, that the growth of the shell of the parasite into the tissues of its host is due to a force similar to that which impels the root of a tree through hard compacted soil.—*John A. Ryder.*

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Animal Music (Am. Nat., April, 1879).—The song of the chickadee is given in but two notes, although the name is derived from five syllables—chick-a-dee-dee-dee. Mr. Nuttall was a close observer of the song of birds, but contented himself with noting only the syllabism. The music of birds differs in form and pitch, as in that of the Baltimore oriole or hang-nest, given by me in the American Naturalist (with the note of the bull-frog, Jan., 1872, p. 234), as compared with that cited by Mr. Clark (April, 1879, p. 222). Gardiner gives nine examples of the song of the English throstle in five keys (Music of Nature, pp. 59, 140, 162, 225, 344, 454), fourteen of the European blackbird in four keys (pp. 59, 76, 130, 140, 162, 434), and others equally scattered and difficult to compare.—*S. S. Haldeman.*

Shedding of the Tracheæ in the Molting of Insects.—While dissecting out the spiracles from the last casting of the larval skin of one of our common silk moths (*B. mori*), I remarked that parts of the trachea remained attached to them. To confirm this observation, I opened a number of cocoons of the ordinary silk worm, which chanced to be in my possession, and placing the shriveled cast skins found in them in potash water, left them for several days to soak and soften. I then succeeded in spreading them out sufficiently to exhibit, attached to each spiracle, a great bunch of tracheal vessels of varying sizes lying parallel, as though they had been drawn out through single openings in the body of the larva. While I cannot be sure that all the finer branches of this tracheal system were present in these bunches, the larger tubes certainly were, and the smaller may readily have been detached and lost in the processes of preparation or broken off and left as dead matter in the body. The fact is clear that in the shedding of the last larval skin at least the tracheal vessels remain attached and are removed with it. When we think of the trachea as portions of the ectoderm or outer layer or skin of the insect, this coincident removal seems only natural and to be expected; but the fact is none the less curious, nor its process more easy to comprehend. Are these vessels with all their ramifications withdrawn from the interior of the larva before the formation of the pupal skin with its spiracles and trachea? and if so, is there not a period during which the insect is without effective respiratory organs.

When the pupa changes into the imago, the same fact is observed. Here also the trachea, of much smaller proportions than in the former case, are found within the empty pupa skin. When does the imago as such begin to breathe with its own proper organs? When it bursts its mummy-like cerements and shakes out its new found wings in this fourth condition of its existence, is there a new birth in this respect also, that it begins at this moment to breathe in its higher life?[1]—*Edward Potts.*

[1] This molting of the tracheæ has been noticed by me in the larva of the humble-bees. See Proceedings Boston Soc. Nat. Hist., x, 283, 1866.—*A. S. P., Jr.*

TWO CHRYSALIDS IN THE SAME COCOON.—Another fact noticed in the examination of the cocoons just referred to surprised me. The first opened, a perforated one, contained two cast larval skins, an empty pupa case and a perfect pupa. Two others, also perforated, in this collection of seventeen, contained each two cast skins and two pupa cases. The situation was puzzling. One other cocoon, like the three former, of unusual size, remained perfect. I cut into it and found two cast larval skins and two perfect pupæ. I could come to no other conclusion than that in each of these four out of seventeen cases, *two worms* had worked together and in partnership spun the cocoons. The proportion in numbers of these abnormal instances is probably altogether fictitious, as the greater size may have invited their selection as specimens. Desirous to obtain some confirmation of this singular state of things, I inquired of a very intelligent Spanish gentleman formerly engaged in silk raising, and learned that while he could not remember having seen two worms actually engaged in forming the same cocoon, he had frequently observed two climbing simultaneously into the same twig and was very ready to believe that when once they had attached their threads to spin, neither would give way, and they thus became enveloped in the same toils. It was therefore his idea that it was rivalry in the search of a favorable location rather than any anticipatory sense of sexual attraction which had led them into these intimate relations. It is much to be hoped that the attention of other observers may during the coming season be directed to a further examination of the above facts, which, so far, I have been unable to find recorded.—*Edward Potts.*

NEW DEEP-SEA FISHES.—The researches conducted by the United States Fish Commission under the direction of Professor Baird, has resulted in the addition of a large number of species to the fauna of the eastern coast of our country. These have been mostly described by Messrs. G. B. Goode and T. H. Bean, whose full and careful diagnoses are valuable additions to ichthyology. At present we notice only those obtained at great depths, since these claim especial interest of the present time. The earliest of these discoveries was that of a new *Chimæra* from near the La Have Bank (Lat. 42° 40′ N.), which was named by Professor Gill *C. plumbea.* The Arctic *Reinhardtius hippoglossoides* has been found at depths below 200 fathoms in the same latitude with the *Macrurus rupestris.* A new *Macrurus* from deep water off Cape Ann is called *M. bairdi.* New species of *Phycis* and *Haloporphyrus* also represent the *Anacanthini.* Several specimens of *Alepidosaurus ferox* have been taken off the same coast between lats. 41° and 44° at depths of from 200 to 400 fathoms.

The most important additions to deep-sea ichthyology ever made is the collection of the *Challenger* expedition, upon which a preliminary report was published about a year ago by Dr.

Günther. As with the American collections, no division receives greater accessions than the *Anacanthini*. Not less than six new genera of this group are described by Günther, four of which he places in the *Ophidiidæ*. Ten species are added to the genus *Coryphænoides*. The *Scopelidæ* prove to be equally characteristic of great depths, fifteen species and three genera being reported as new. Perhaps the most interesting novelties are five new species of *Alepocephalidæ*, which belong to four genera, of which three are new. The total number of species described by Günther is sixty-one.

To Prevent Grease from Injuring the Plumage of Birds.—I have received the following letter which speaks for itself.—*Elliott Coues.*

Clinton, Conn., April 12, 1879.

Dr. Coues:

Dear Sir:—In your Field Ornithology you speak somewhat despairingly of preventing the oil from injuring the plumage of fat birds, and I write to tell you of an experiment that I have tried, and which I believe is a success. A month since I put up a goosander whose skin was thick and very oily. Taking off the leaves of fat, my next thought was of how to prevent the saturation of the feathers, and I hit upon this experiment. Being a dentist and accustomed to the use of absorbents, I took a piece of spunk, of which I enclose a sample, cut it of an oval shape and large enough to reach pretty well up on the side of the tow body, pinned the edge smoothly to it, and as it is of a uniform thickness, it made a good surface for the skin to lie against.

This specimen has been in my laboratory all the time during these weeks, exposed night and day to the ordinary temperature of a house heated by a furnace, and shows not in the slightest degree any appearance of oil, while another specimen with a very similar skin is completely saturated beneath.

I take the liberty to write on this subject as it may lead to a satisfactory solution of the problem, how to keep the oil from soiling the plumage in fat birds.

Very truly yours,

A. H. Stevens, Clinton, Conn.

Another Siredon.—M. Velasco has recently published in the Memoirs of the Mexican Society of Natural History for 1878, a description of a species of *Amblystoma* and its metamorphoses, under the name of *Siredon tigrinus*, which is found in lake Santa Isabel, in the valley of Mexico. M. Velasco names the species as new, but we cannot perceive that it is different from the yellow-spotted varieties of the *Amblystoma mavortium* of Baird. The metamorphoses of Mexican specimens of this species have been observed by Duméril, and Sumichrast has sent specimens of the same from the elevated regions of Vera Cruz. M. Velasco gives

us the most southern locality yet known, and illustrates its characters with some very good figures. Will not some of the naturalists of Mexico give us an account of the metamorphoses of the *real Siredon*, the *S. mexicanus*, from the city of Mexico? No one has yet described it, if any there be.—*E. D. Cope*.

LOTA MACULOSA IN THE SUSQUEHANNA RIVER.—About twenty years ago Mr. J. M. M. Gernerd caught a specimen of this fish in a net at Muncy, Lycoming county, Penna. He preserved it in his collection and recently sent it to Philadelphia. It is about a foot long. Mr. Gernerd says that he has fished a great deal, but has never seen another specimen. It has not been previously reçorded from the Susquehanna river.—*E. D. Cope.*

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The paper following that of Dr. Topinard, in the *Bulletin* of the Société d'Anthropologie de Paris for 1878, pp. 66–92, is by Dr. Paul Broca, the distinguished anatomist, upon the indices of breadth in the scapula of man, the apes, and the series of mammals. Three tables of indices close the communication. To M. Broca, perhaps, more than to any other anatomist living or dead, we are indebted for the application of rigorous methods and instruments of precision to various parts of the skeleton, which are likely to yield precious results in deciding the exact place of man in nature.

On page 104, M. Gustave Le Bon discusses the inequality of the corresponding regions of the cranium. The measures were taken on 300 skulls from different series in the collection of the Anthropological museum. Long ago students inquired whether the two hemispheres of the brain was equal, and Bichat considered that a default of symmetry was accompanied by a lack of rectitude in judgment. The autopsy of that illustrious anatomist, whose skull was exceedingly irregular, shows what a poor foundation we have for such a theory. In man most of the organs are more developed on the right side than on the left; but taking into consideration that the left portion of the brain presides over the functions of the right side of the body, we might suppose, *a priori*, that it is the left hemisphere of the brain which should be the most developed. Upon the 287 skulls that I have measured, in taking for a starting point the vertical plane passing through the external occipital protuberance and the prolongation of the median suture of the nasal bone, the following results obtained:

Skulls where the right side predominates	125
" " " left " "	111
" " " different bones are unequal, but whose inequalities are compensatory	51
	287

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

The foregoing observations demonstrate that the cranium, and therefore probably the brain whose form it reproduces, presents a lack of symmetry which is not of the same character for each of its parts.

On page 121, Dr. Le Bon describes a very simple anthropometric instrument, which he calls the pocket cephalometer, or compass of co-ordinates, designed to obtain very rapidly the different diameters, angles, and profiles of the head, and to reproduce in relief any solid figure whatever. A description of this instrument without drawings would hardly define it; we must therefore refer our readers to the paper of Dr. Le Bon.

On page 161, Dr. Thulié gives an account of the autopsy of Louis Asseline, a member of the Société d'Anthropologie and of the Société d'Autopsie Mutuelle. Asseline was 49 years old when he died. In politics, he was a republican; in philosophy, a materialist. After his education was finished, he came to Paris, where he contributed more than all others towards propagating those ideas which resulted in the overturning of the empire. He was the founder and patron of several radical journals, and was frequently imprisoned for his writings. He was also in political life several times.

Asseline was a member of the Société d'Autopsie, composed of individuals who believe that the study of the brain of a man whom we have known, not only through his works, but in his character and faculties, would contribute to the advancement of science. The first subject of mutual autopsy was Jules Asséza, who, by the way, did not derive much benefit from the mutual clause in the society's constitution. The second was M. Asseline, whose autopsy occurred 39 hours after his decease. The brain weighed 1.468 grammes, which may be compared with Broca's table of means:

From 31 to 40 years	1.404 grammes.
From 41 to 50 years	1.403 "

Since Asseline was 49 years old, his brain-weight was considerably above the mean. The convolutions are large and thick. M. Broca on examining the brain, said "Ce n'est pas un cerveau fin, les circonvolutions sont épaisses, presque grossiéres." A remarkable fact, since that which characterized the intelligence of M. Asseline was an exquisite finesse pushed even to subtlety. There occurs upon this brain the *calotte*, regarded as a sign of inferiority by Gratiolet. Among the apes, indeed, the parieto-occipital fissure is profound; on the gorilla only M. Broca has observed this fissure to be deep on one side and superficial upon the other. This fissure is frequently deep in woman, as well as in some men of known intellectual mediocrity. In the brain of Asseline the *plis de passage* are profound, especially upon the left. This sign of inferiority should be studied; and we have a right to demand in the presence of this brain whose anterior parts

are so developed and which correspond to eminent intellectual faculties, if the development of the *plis de passage* does not correspond with secondary faculties The cranial calotte is extremely thin. It is not a senile regression. The cerebral depressions and the vascular furrows are very marked, as if the internal table had been thinned by the enlarging of the brain. The frontal suture is not entirely ossified; it is less so than the parieto-occipital suture which is not entirely closed. There exists a certain asymmetry in the osseous vault; the frontal eminence on the right side is more prominent than on the left. A more extended account of the investigation is promised in future.

On page 173, M. Maurel describes the pre-historic man of Guiana, and on page 186, the same author presents an anthropological and ethnographical study of two tribes of Indians, the Aracouyennes and the Galibis, living on the river Maroni, Guiana. On page 230, Dr. Broca speaks of the skulls and objects of industry found by M. Bert, Thiahuanuco, Peru. Dr. Maurel presents a communication, pp. 260 to 269 upon the frequency of dental caries among the Galibi Indians and their offsprings of mixed blood with the blacks.

The first number of Vol. III, Proceedings of the Davenport Academy of Natural Sciences, contains a very full report on the condition and progress of the institution during the year 1878. In the address of the retiring president, Dr. Farquharson, we have a review of the results attained concerning the celebrated inscribed tablets and the still more remarkable elephant pipe. With regard to the tablets the doctor remarks: "If there are now any doubters of the authenticity of these 'precious monuments,' as M. Lucien Adam is pleased to call them, they are silent, either from their doubts having been dispelled by the accumulation of material evidence, or it may be that they deem us so incorrigible in the continued fabrication of these relics that remonstrance would be wasted on us."

The academy has taken the lead in another branch of anthropology, which might be called the natural history of the heart or affections, and elected a lady, Mrs. Mary L. D. Putnam, to the presidential office for the ensuing year. Dr. Parry in making the nomination said: "It is quite unnecessary to explain to any here present that the actual success and present prosperity of the academy has been coincident with the interest taken in it by woman. The very ground beneath our feet is the spontaneous gift of a generous woman."

Dr. Edmund Andrews contributes to the Transactions of the Wisconsin Academy, a paper on the literature and religion of the mound-builders, in which he takes the ground that they are not extinct, as popularly supposed, but still exist among our Indian tribes.

In the same volume Dr. C. R. Hoy gives us a discussion upon

the method by which the aborigines manufactured copper implements. The doctor takes the ground that none of these implements were cast, since the moulds were too difficult of management for the intelligence of American savages. "Copper is a refractory metal which melts at 2200 to 2600 degrees, a temperature that can be reached only in a furnace, assisted by some form of coal and an artificial blast. It is, when melted, thick and pasty, and without the addition of some other metal will not run in the cavities and sinuosities of the mould. A majority of the copper implements found have specks or points of pure silver over their surfaces; now one single speck of pure silver, visible even with the microscope, is positive evidence that the specimen was never melted." Dr. Hoy then proceeded to give his views of the methods of savage metallurgy. The Indians used fire in their mining operations. The vein rock was made hot by building a fire on or against it. Then by dashing water on the heated mass the rock would be fractured and removed, leaving ragged masses of copper exposed, which would also be softened so that it could be beaten into shape. When the metal became hard by pounding, it was again heated and plunged into water; for copper is, in this respect, the opposite of steel. In this way copper was fashioned simply by pounding.

In addition to the hammering process, cylindrical articles were evidently rolled between two flat rocks. Some of those implements that are supposed to have been cast were probably swedged; that is, a matrix was excavated in stone, into which the rudely fashioned copper was placed, and then by repeated blows the article was made to assume the exact shape of the mould. Besides this swedging process, Dr. Hoy is persuaded that in a few instances a complete mould was wrought out in halves on the face of two flat stones, so that by placing a suitable piece of copper between them and giving it repeated heavy blows the metal was made to fill the mould accurately. In order to test the matter the doctor constructed a mould of this description and was able to make a beautiful axe.

In the same volume of the Transactions, Dr. J. M. de Hart discusses the antiquities and platycnemism of the Mound-builders of Wisconsin.

Mr. Lester F. Ward sends us a pamphlet printed by Edward Stern & Co., of Philadelphia, containing his papers on Haeckel's Genesis of Man, which appeared in the April, May and July numbers of the *Penn Monthly* for 1877. As this celebrated work of the author has not yet been translated into English, Mr. Ward has done a useful thing in presenting the views of Prof. Haeckel in a clear and succinct manner.

GEOLOGY AND PALÆONTOLOGY.

A PECULIAR CAVE IN UTAH.—The Oquirrh range of mountains, in Utah, extends northward as far as Great Salt lake and borders

the lake for a short distance along the south-east shore. Near Lake Point, as in many other places, old lake beaches or "benches" can be traced on the side of the mountain, the highest having an altitude of about 900 feet. In some places four distinct ones can be seen. On one of the benches a cave opens into the carboniferous limestone, of which the mountain is mostly composed. This cave, known as Clinton's cave, was first brought into public notice by Mr. G. K. Gilbert,[1] who described it and explained the probable mode of its formation. Later Dr. A. S. Packard, Jr., published an interesting account[2] of several species of cave animals which he found living there. He also determined its geological age to be most probably the Quaternary. Having recently visited it and made a discovery which seems to throw some light on the mode of its formation and its age, I am enabled to verify their conclusions and to give further particulars.

The strata forming the mountain are here uplifted into nearly a vertical position. One stratum having a thickness of ten or twelve feet, seems to have been composed of a softer material than the adjacent ones. When the water of the lake stood at about the level of the bench on which the cave is now situated, the action of the waves in breaking upon the rocky shore gradually wore away this soft stratum until a long narrow crevice had been excavated into the side of the mountain. Similar action is going on to-day on the coast of New England, where dykes of porphyry are exposed to the direct action of sea-waves, the porphyry being worn away faster than the wall-rock.

After thus cutting horizontally to a depth of over 300 feet, and vertically to the surface of the slope for the whole distance, the lake evidently subsided sufficiently to allow of an accumulation of coarse sediment which was washed from the slope above, filling the crevice, and which was cemented into a conglomerate by carbonate of lime. Then the lake rose again to the level of this bench and dug its way into the conglomerate; but instead of cutting upward to the surface it tunneled horizontally as far as before and formed a cave, the height of which to the roof is nowhere more than twenty-five or thirty feet. The width varies from about twelve feet at the mouth to three feet at the innermost extremity.

An indication that this is the probable mode of its formation is afforded by the discovery to which I previously referred. While in Utah during the past summer, I visited the cave with Dr. Packard for the purpose of more fully investigating its fauna. The floor is composed mainly of earthy materials with an occasional layer of marl, in which Dr. Packard found several species

[1] Report on the Geology of Portions of Nevada, Utah, &c. G. K. Gilbert, A.M. Wheeler's Report, Vol. III, p. 98.

[2] On a New Cave Fauna in Utah, by A. S. Packard, Jr., M.D. Bulletin of U. S. Geol. and Geog. Survey, F. V. Hayden, U. S. Geologist-in-charge Vol. III, No. 1.

of fresh-water shells. Several large masses of the conglomerate which forms the roof have fallen to the floor. While examining one which seemed to have fallen very recently, as it was not imbedded in the earth, I found enclosed in the rock, a land shell which has kindly been identified by Mr. W. G. Binney as *Patula strigosa* var. *Haydeni.* Further search failed to bring to light other specimens.

The great thickness of the conglomerate above the position of the shell precludes the idea that the filling took place at a very recent period. The same species is now found living in abundance in the vicinity of the lake. Its presence as a fossil undoubtedly proves the formation to belong to the Quaternary.

The discovery seems to be of interest on another account. Although the conditions of life must have been much varied since the deposit of the specimen in the conglomerate, the species retains, at the present time, even its varietal markings in great distinctness, a further evidence that all groups are not equally affected by climatic changes.—*Leslie A. Lee.*

THE BAHNA BASIN.—M. Stephanesco, of Bucharest, has communicated to the Geological Society of France a description of the geology of the region of the Iron Gate of the Danube, on the extreme west of Roumania. Azoic beds are extensively developed on this part of the Danube, which are overlaid at one point by a band of Cambrian, which crosses the river below the gates. Lower down, a Tertiary formation appears, resting partly on the Azoic and partly on some secondary beds. Above the gates the Bahna creek enters from the north, after traversing a valley in which is situated the town of that name. This valley is excavated in upper and middle Miocene marine beds, which themselves form a synclinal series, with the opposing dips of 45° separated by a central fracture. M. Stephanesco points out that the relations of these beds, lying as they do directly on the Azoic, is similar to that seen in the basins of Vienna, Bordeaux, Dax and that of the north of Italy.

A NEW ANCHITHERIUM.—At a recent meeting of the Philadelphia Academy, Prof. Cope exhibited crania of three species of *Anchitherium* from the Truckee beds of Oregon, one of which he regarded as new to science, and named, on account of its superior size, *A. præstans.* It is the largest species yet found in America, and exhibits the typical characters of the genus. On the posterior border of the superior molars there is a trihedral tubercle in front of the elevated posterior cingulum, but the anterior cingulum does not rise into a tubercle, nor is there an accessory tubercle near it. The internal lobes of the crown are closely connected with the median lobes. External ribs and cingulum prominent; enamel smooth. The side of the face is concave, and there is a lachrymal fossa. The anterior border of the orbit

marks the middle of the last molar tooth. Length of molar series, .118 m.; of true molars, .050; length anterior to molars, .061; width between last molars, .040; diameters of crown of second true molar, fore and aft, .017, transverse, .022; length of tibia, .285; of metacarpal, .221.

GEOGRAPHY AND TRAVELS.[1]

GEOGRAPHICAL PROFESSORSHIPS. — The Council of the Royal Geographical Society have presented a Memorial to the Oxford and Cambridge University Commissioners urging the importance of establishing Geographical Professorships. Although there is no such chair existing in any American university, and although it may be as well said of America as of England, that "there are few countries in which a high order of geographical teaching is so little encouraged," the importance of such knowledge is recognized here, and the popular interest in scientific exploration is rapidly extending. It may be well, therefore, to call the attention of our educational authorities, especially those of our new and magnificently endowed universities, such as the Johns Hopkins and the Lehigh to this address. It is given in full in the "Proceedings," of the society for April last.

The Council include in the word Geography "a compendious treatment of all the prominent conditions of a country, such as its climate, configuration, minerals, plants and animals, as well as its human inhabitants; the latter in respect not only to their race, but also to their present and past history, so far as it is intimately connected with the peculiarities of the land they inhabit." * * * * * "Among the many classes of problems that fall under these heads, it is sufficient to specify two. The one deals with the reciprocal influence of man and his surroundings, showing on the one hand the influence of external nature on race, commercial development and sociology, and, on the other, the influence of man on nature, in the clearing of forests, cultivation and drainage of the soil, introduction of new plants and domestic animals, and the like. The other problem deals with the inferences that may be drawn from the present distribution of plants and animals, in respect to the configuration of the surface of the earth in ancient times. Thus we see that the mutual relation of the objects of the different sciences is the subject of a science in itself, so that scientific geography may be defined as the study of local correlations.

"Geography thus defined does not tend in any degree to supersede the special cultivation of the separate sciences, but rather to intensify the interest already felt in each of them, by establishing connections which would otherwise be unobserved. It is through geography alone that physical, historical and political conditions are seen to be linked closely together; and it is thus that geog-

[1] Edited by ELLIS H. YARNALL, Philadelphia.

raphy claims the position of a science distinct from the rest, and of singular practical importance."

The Council also mention that in France the State has endowed seven chairs of geography besides providing instruction of a high class in the Lycées. Seven of the German universities are also provided with professors of the science, and there are three chairs in Switzerland. "The literary results of German travel at the present day seem to show that the educational advantages which are attainable in Germany have borne fruit in developing and directing the powers of observation in German travelers."

"A copious collection of maps, models, pictures and ethnological illustrations of the various lands which are the theatres of historical study, would gradually accumulate under the charge of a professor of geography, and would enable him to illustrate their configuration and scenery as well as the social character of their inhabitants with a fullness that no ordinary teacher could hope to rival. Such illustrations, it may be remarked, are consistent with the general tendency of modern instruction."

GEOGRAPHICAL NEWS.—The *Nature* states that a large amount of material for arriving at some approximately correct notion of the mean depth of the sea having been accumulated in recent years, Dr. Krümmel has lately attempted this. Soundings were wanting for the Antarctic and a part of the North Polar sea, *i. e.*, about 475,000 square miles, or seven per cent. of the entire sea surface, so that he gives his estimate only as a closer approximation. He estimates then the mean depth of the sea as 1,877 fathoms, or 3,432 metres, or 0.4624 geographical mile. It was natural to compare the mean height of dry land above the sea-level. Humboldt's estimate of 308 metres is regarded as quite out of date. Leipoldt has since estimated the mean height of Europe as 300 metres. Accepting this number for Europe, 500 for Asia and Africa, 330 for America, and 250 for Australia, Dr. Krümmel obtains the mean of 420 metres, or 0.0566 mile. The surface ratio of land to water being considered 1 : 2.75, the volume of all dry land above the sea-level is inferred to be 140,086 cubic miles, and the volume of the sea 3,138,000 cubic miles. Thus the ratio of the volumes of land and water is 1 : 22.4. That is, the continents, so far as they are above the sea-level, might be contained 22.4 times over in the sea-basin. Reckoning, however, the mass of solid land from the level of the sea-bottom the former would be contained only 2.443 times in the sea space. Dr. Krümmel also compares the masses (taking recent data); he finds that of the sea 3,229,700 cubic miles, and that of the solid land 3,211,310 (a small difference). If the specific gravity of the land were raised merely from 2.5 to 2.51432, we should thus have perfect equilibrium. Such equilibrium is probably the fact.

Col. Prejevalsky started on his Central Asian journey on the 1st of February last, Ensigns Eklon and Roborovsky and two

subordinates accompanying him. At Kuldja he will be joined by the same interpreters as were with him on his last journey, and at Zaissan by five cossacks. From here the expedition will start with thirty camels and some horses for Hami and Suh-chau, and thence proceed to the Kansu mountains. The party will next make for Lhassa by the usual route, and by February, 1880, hope to reach the Himalayas by way of the Brahmapootra river. Returning then to Lhassa he will visit Khotan, Kashgar and cross the intervening plateau to Russian Khokand. The journey is to occupy two years. He has been most fully equipped for this arduous task, the Russian Geographical Society having contributed 20,000 roubles. If he can but accomplish a third of his programme, he will have done a great service to geography.

Friedländer & Son, of Berlin, have recently commenced the publication, every two weeks, of a journal, *Naturæ Novitates*, which contains a fortnightly bibliographical list of current literature in all languages in the various departments of science.

The Royal Geographical Society has undertaken to organize a uniform system of spelling the names of places throughout the globe. A commencement has been made with Indian names. After these are tabulated and revised the society propose to turn their attention to African names. They hope finally to establish a universal set of rules applicable to all parts of the world.

We learn from the *Academy* that a Norwegian captain named Bjerkan spent the winter of 1876–7 at Möller bay, on the west side of Novaya Zemlya. His journal, containing observations from October 4th to June 11th of the temperature of the air and sea, and the direction of the winds, has been published. These records show a decided maximum of temperature in January 4°.4 F. above the means of either December or February. This peculiarity is also noticeable, says the *Academy*, in all the existing records from Novaya Zemlya and in the Austrian observations on Franz Joseph Land, and is therefore not confined to the period of Capt. Bjerkan's stay. This high temperature was accompanied by prevalent southerly winds, but the absence of barometrical observations makes it impossible to say whether these winds were due to the passage of cyclones to the northward of the station in the month of January.

A small scientific expedition left Denmark in April of this year to explore portions of the coast of Greenland, their object being chiefly to examine the fiords between the Danish colonies of Holsteinborg and Egedesminde. Excursions are also to be made into the unknown regions of the interior, and scientific observations of various kinds will be taken.

The Church Missionary Society (London) have published two large wall maps of Africa for the use of lecturers. One exhibits the whole continent and the other the equatorial lake district.

A new edition of the Library Map of Africa, scale 1 : 5,977,382,

prepared by Keith Johnston, F.R.G.S., is published by Stanford (London).

A new map of Africa by the same editor, on a smaller scale, 1 : 8,420,000 has also been published by W. & A. K. Johnston (Edinburgh).

MICROSCOPY.[1]

AMERICAN SOCIETY OF MICROSCOPISTS.—The local committee at Buffalo have secured the use of the "Central School Building" for the sessions of this society at its meeting in that city in August. The headquarters of the officers will be at the Tifft House, and local and general arrangements are being made which it is believed will be fully adequate and satisfactory. Excursion fares upon the railways and reduced hotel rates have been promised, and private hospitality will be tendered when desired. A soiree will be given under the auspices of the local microscopical society. The provisional constitution adopted at the Indianapolis meeting will come up for amendment and adoption, and all microscopists of the country are cordially invited to attend and participate in the perfecting of a permanent organization. Circulars giving full information in regard to the plans for the meeting can be obtained by addressing the secretary of the society, Dr. Henry Jameson, of Indianapolis, Indiana, or the secretary of the local committee, Mr. James W. Ward, of Buffalo, N. Y.

ROYAL MICROSCOPICAL SOCIETY.—With an evident desire to share its prosperity with others, this society is renewing and extending its efforts to make itself a center of influence in the cultivation of microscopical science throughout the world. Its journal, under the honorary editorship of Mr. Frank Crisp, LL.B., one of the secretaries of the society, has become a superb magazine of microscopical science. By a recent action of the society fifteen honorary fellows were elected, including Dr. J. Leidy, of Philadelphia. Nearly seventy societies, in different parts of the world, were also designated, whose presidents for the time being should be ex-officio fellows of the society. As this arrangement includes the honorary distribution of the "Journal," it is a very generous as well as very judicious action. The societies in the United States included in this arrangement are the American Academy of Arts and Sciences, of Boston, the Boston Society of Natural History, the State Microscopical Society of Illinois, the New York Academy of Sciences, the New York Microscopical Society, the Philadelphia Academy of Natural Sciences, the San Francisco Microscopical Society and the Troy Scientific Association.

NEW YORK MICROSCOPICAL SOCIETY.—This society has removed to its new rooms at No. 239 Fourth avenue, near Nineteenth street, where it will meet on the first and third Friday evenings

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

of each month, except July and August. It is also having excursions during the summer, after the manner of the Queckett Club.

The Propagation of Cluster-cups.—Dr. M. C. Cooke, in his "Introduction to the Study of Microscopic Fungi," calls attention to the difficulty of accounting for the appearance of the cluster-cups (*Aecidiacei*) bursting through the cuticle of the leaves of the plants on which they are found. The question is as to the manner in which their spores reach the interior of the leaf where they germinate. It certainly cannot be by way of the stomata, for these are too small, nor would this account for the preservation of the spores until the succeeding year. Equally difficult is it to imagine a process by which they can gain access to the interior of the growing leaf through the roots, nor have they been traced passing through the tissues of the plant. The author named mentions the fact, however, that Rev. M. J. Berkeley was able to propagate Cluster-cups by growing plants from seeds which had been placed in contact with their spores. Following this hint and noting the fact that the species growing in this vicinity ripened and discharge their spores at the time when the plants on which they are found are in blossom, it was easy to reach the conviction that these spores would be found along with the pollen in the interior of the ovary, thus coming into contact with the seeds and depositing the germs of future growth. Acting upon this hypothesis, I have examined the flowers of *Podophyllum peltatum* and *Arisæma triphyllum* growing within a few feet of plants of the same species whose leaves were covered with Cluster-cups, and in many instances have found the orange-colored spores among the pollen in the ovary. Likewise I have found pollen from *Podophyllum peltatum* mingled with the spores dusted over the leaves of a plant of the same species at a distance of several feet from any blossom, indicating apparently that it had been transported by insects.—*M. A. Veeder.*

National Committee on Micrometry.— Prof. Wm. Ashburner, of San Francisco, Cal., and Rev. Samuel Lockwood, of Freehold, N. J., have been added to this committee.

Erratum.—In the last line of "Microscopy," in the last number of the Naturalist, for "Kill's cement" *read* Bell's cement.

——:o:——

SCIENTIFIC NEWS.

— Dr. Elliott Coues contributes to the June number of the *Penn Monthly* some interesting correspondence of the ornithologists, Wilson, Ord and Bonaparte.

— A *Sphargis coriacea*, weighing 765 pounds, was recently taken in the Delaware river, near Fort Delaware. It was purchased by Prof. Cope for the Permanent Exposition at Philadelphia.

— The American Association for the Advancement of Science will hold its thirty-eighth meeting at Saratoga, N. Y., opening on Wednesday, August 27th next. The permanent subsection of chemistry will be continued at Saratoga under the chairmanship of Prof. Ira Remsen, of Baltimore. The permanent subsection of microscopy will be presided over by Prof. E. W. Morley, of Hudson, Ohio, and the coöperation of microscopists is requested. The permanent subsection of anthropology has united with section B at the late meetings, a day having been specially allotted to anthropological papers. A chairman was not elected for the Saratoga meeting, but it is understood that this subsection can reorganize at Saratoga should the anthropologists present consider it desirable. In this connection it is proper to note that there will probably be a meeting of the American Anthropological Association during the association week. The attention of entomologists is directed to the annual meeting of the Entomological Club of the association, which will be held at Saratoga on Tuesday, August 26th, at which all interested are invited to be present. Mr. J. A. Lintner, of Albany, is president, and Mr. B. P. Mann, of Cambridge, secretary of the club. At the St. Louis meeting the permanent secretary was directed to call special attention to the desirability of forming a new subsection in the association, which should be devoted to physiology and anatomy, with the special object of inducing members interested in human physiology to bring their papers before the association and also of obtaining the active coöperation of physicians and surgeons in the work of the association. The president of the association is George F. Barker, of Philadelphia, and the permanent secretary, F. W. Putnam, whose address is Salem, Mass.

— The following was recently received at the Philadelphia Zoölogical Garden by the superintendent. On inquiry it proved to be *bona fide:*

"Too the Manager of the zeoological Garden.

Phil June 2 79.

Sir I have Somethinge wich is without any misstack a Grate novilty too the public & is no Cost it is a alactrick Fish wich lives in Fire as well as in water it proueduce fire & Smoke.

PROFF LYONS."

— Charles Hallock, Esq., who is the author of several books on field sports, and the editor and founder of *Forest and Stream*, the well-known sportsman's journal, has just issued a fifth edition of his "Sportsman's Gazetteer and General Guide," a most complete encyclopedia of 921 pages. This book has become a standard authority on all subjects of which it treats; besides, it is endorsed by leading scientists. It has already been republished in England, France and Germany.

— Prof. Viand, Grand Marais in Nantes, France, is desirous of obtaining American lichens in exchange for European.

— Noteworthy arrivals at the Zoölogical Garden, of Philadelphia: 27 undulated grass parrakeets (*Melopsittacus undulatus*); 1 red and yellow macaw (*Ara chloroptera*); 1 red-headed duck (*Fuligula ferina americana*); 1 macaque monkey (*Macacus nemestrinus*), born in the garden; 1 white-fronted parrot (*Chrysotis leucocephalus*); 1 blue-fronted parrot (*Chrysotis cyanorhyncha*); 1 pouched rat (*Geomys bursarius*); 1 whistling swan (*Cygnus americanus*); 2 ostriches, 1 ♂, 1 ♀ (*Struthio camelus*); 1 oryx antelope, ♀ (*Oryx leucoryx*); 1 red monkey (*Cercopithecus ruber*); 1 green monkey (*Cercopithecus callitrichus*); 1 common skunk (*Mephitis mephitica*); 2 green lizards (*Anolis principalis*); 3 prairie wolves (*Canis latrans*); 1 red kangaroo (*Macropus rufus*) and 1 great kangaroo (*Macropus giganteus*), all born in the garden; 2 Pennant's parrakeets (*Platycercus pennantii*); 2 Rosehill parrakeets (*P. eximius*); 2 blood-rumped parrakeets (*P. hæmatonotus*); 4 yellow-collared parrakeets (*P. semitorquatus*); 4 chestnut-eared finches (*Amadina castanotis*); 2 spotted-sided finches (*A. lathami*); 2 chestnut-breasted finches (*Donacola castaneothorax*); 2 maja finches (*Munia maja*); 2 spotted munias (*M. undulatus*); 1 buffalo ♂ (*Bison americanus*), born in the garden; 1 loon (*Colymbus torquatus*); 2 European fallow deer (*Dama vulgaris*) ♂ ♀; 2 European badgers (*Meles taxus*) ♂ ♀; 1 gray ichneumon (*Herpestis griseus*); 3 anubis baboons (*Cynocephalus anubis*), 1 emu (*Dromæus novæ-hollandiæ*; 1 scarlet ibis (*Ibis rubra*); 3 bar-headed geese (*Anser inaicus*), India; 1 secretary vulture (*Gypogeranus serpentarius*), S. Africa; 4 ring-necked pheasants (*Phasianus torquatus*); 1 darter, or water turkey (*Plotus anhinga*), Florida; 7 white-footed mice (*Hesperomys leucopus*), born in the garden; 1 star-nosed mole (*Condylura cristata*); 2 laughing king-fishers (*Dacelo gigantea*), Australia; 4 Swainson's lorikeets (*Trichoglossus novæ-hollandiæ*); 1 gray parrot (*Psittacus erythacus*); 2 Javan chevrotains (*Tragulus javanicus*) ♂ ♀, Java and Sumatra.

— We would call attention to Mr. W. N. Lockington's article "The Flounders of our Market" [San Francisco], (Scientific Press Supplement, San Francisco, Cal., Vol. 1, No. 3, April, 1879), as from its place of publication it is likely to escape the eyes of naturalists. There are notes on *Hippoglossoides melanostictus* (Girard sp.) Lockington, *Uropsetta californica* (Ayres sp.) Jordan, *Citharichthys sordidus* Gunther, *Hypsopsetta guttulata* (Girard sp.) Lockington (*Paropheys ayresii* Gunther), *Pleuronichtys cænosus* Girard, *Parophrys vetula* Girard, *Lepidopsetta bilineata* (Ayres sp.) Jordan, *L. umbrosa* (Girard sp.) Lockington, and *Platichthys stellatus* Günther. Two new species, *Hippoglossoides jordani* and *Glyptocephalus pacificus*, are described.—*J. S. K.*

— An observation lately made by M. Collot, in Panama, lends support to the opinion that the phylloxera is an insect indigenous

in North America, not introduced from Europe with cultivated vines. In the woods of Panama, so far from any center of cultivation of the vine, M. Collot noticed the phylloxera on a wild native vine, which clings to trees after the manner of tropical trullweed.

— The biennial oration in memory of John Hunter was delivered by Prof. Humphry, of Cambridge, F.R.S., in the lecture-room of the Royal College of Surgeons, February 14.

— The following from a recent number of the *Yuma Sentinel*, is not without interest:

"A herd of camels was driven here from Nevada nearly two years ago. Finding no profitable work for them their owners turned them loose along the Gila to the eastward of Yuma. There they have been living and breeding, looking fat and sleek all the time. For a while they were in danger of extermination. Whenever they put in an appearance along the wagon road they frightened mules and horses beyond the control of the drivers. They soon earned the everlasting hatred of teamsters, some of whom acquired a habit of shooting camels at sight. Since, however, the railroad has been delivering freight at Adonde, the road along the Gila, this side of that place, has been comparatively abandoned by teamsters, and the remaining camels have now a good chance to show what they can do in the way of propagation. The waterless desert of Sonora, south and south-east of Yuma, is known to possess immense deposits of salt, sulphur, borax and soda. Its mountains are also known to carry extensive deposits of metals. To these camels we look for eventually making these treasures accessible and available."—*R. E. C. S.*

— The doubt as to whether science or high rank should be represented in the presidency of the Zoölogical Society has been solved by the unanimous election of Mr. William Henry Flower, F.R.S., &c., conservator of the Museum and Hunterian Professor of Comparative Anatomy at the Royal College of Surgeons.

— The Permanent Exposition of Philadelphia, now occupying the main building of the Centennial, has adopted some changes in its organization which will give it a much more specially educational tone than heretofore. It has been divided into ten departments, over each of which a competent chief has been placed. Particular provision has been made for a great museum of the materials of the natural sciences, three of the departments together covering the subjects therein embraced; to these has been assigned a space of six acres within the building. The organization of the executive board is as follows: President, Edward Shippen; secretary and superintendent, W. T. Seal; vice-presidents, Ellis A. Apgar, Geo. F. Barker, Geo. Blight, John F. Hartranft, D. Newlin Fell; chief of the department of inorganic material, Persifor Frazer, Jr.; chief of the department of organic

material, Edward D. Cope; chief of the department of archæology and ethnology, Edwin A. Barber; chief of the department of national architecture, furniture, costumes and traits, George W. Hewitt; chief of the department of model homes, William S. Schofield; chief of the department of agriculture, Willis P. Hazard; chief of the department of machinery, apparatus and manufactures, E. Gybbon Spilsbury; chief of the department of industrial training, Rudolphus Bingham; chief of the department of schools, school-systems and publications, Edward Shippen; chief of the department of fine arts, George W. Pettit.

The prospectus for 1879 contains a series of announcements from Dr. J. A. Paxson, the president, W. T. Seal, secretary, and from each of the chiefs of departments. Those of Profs. Frazer and Cope, and of Mr. Barber, present plans for the classification of their respective museums, which indicate a determination to do their respective charges ample justice. They commence under the favorable conditions of unusually fine collections already in hand, and it will only depend on the public spirited citizens of Philadelphia whether she has a museum appropriate to her population and importance or not. The advantage of having her museums under one roof is almost unique, and should recommend the new organization to immediate support.

— The district of Shantong, in China, contains diamond deposits of a certain importance, but the stones in which the diamonds are found are generally very small—rarely the size of a pea. The following singular artifice (we learn from *Annales Industrielles*) is resorted to by to the Chinese to obtain them. Men wearing large and thick boots made of straw walk in the sand of diamantiferous valleys and watercourses. The diamonds, generally rugose and angular in form, penetrate into the straw, and remain fixed there. Afterwards the boots are collected *en masse* and incinerated, and the precious stones are found among the ashes.—*English Mechanic.*

— We have received the announcement for 1879, of the Appalachian Mountain Club, containing the Constitution and By-laws, list of officers for 1879, and the list of members. The president for this year is Prof. W. H. Niles, of Cambridge, Mass.

— The report on the condition and progress of the Davenport Academy of Natural Sciences, shows that this society is one of the most active in the West, and that this is due largely to two or three individuals, sustained by an enlightened and progressive constituency.

— A number of the citizens of Atlanta have organized a Scientific Association, with the following list of officers, for the purpose of having lectures on scientific subjects delivered weekly free to the public, and to collect a library of scientific works, and to provide a museum of specimens of minerals, rocks, ores, woods, plants

and animals, to be kept open to the public on fixed days, and to workers in science at all times. They have a commodious hall, furnished with shelves, and a janitor in charge of the same. It is near the centre of this growing city of 35,000 inhabitants. Officers, Geo. Little, president; Fred. Bell, vice-president; G. W. Kates, secretary; J. M. Ellis, treasurer; J. S. S. Bell, librarian (pro tem). They have already had about 40 lectures by professors in the State university, and other scientific gentlemen. They would be glad to receive publications as valuable additions to the library. Any contribution to the museum will also be gratefully received.

— The Transactions of the Kansas Academy of Science for 1877 and 1878, contains a number of short articles of much general interest. Prof. F. H. Snow contributed a number of lists of Colorado and Kansas insects. Prof. B. F. Mudge contributes an article entitled, The connection of the fossil forests of the Dakota Groups in Kansas with the fossil forests of Greenland; and S. W. Williston gives a brief popular resumé of existing knowledge of the Dinosauria.

— A number (issued March 4, 1879,) of Siebold and Kölliker's Zeitschrift gives the names of authors and a detailed index of all the articles which have appeared in volumes 16–30, and the supplementary volumes 25 and 30.

— In Ethopia there is found, in subterranean cavities (according to M. Villiers), a honey made without wax by an insect resembling a large mosquito. This honey is called *tazma*. The natives use it to cure throat disease. On analysis, M. Villiers finds it to contain 32 per cent. of mixed fermentable sugars and 28 per cent. of dextrine. The composition is like that of mannas of Sinai and Kurdistan, saccharine matter from the leaves of the lime-tree, and ordinary honey; but it differs from those substances in the absence of cane sugar.

— The results of the disastrous phenomenon of sudden freezing of rain in France, lately referred to, are now coming more freely to light. In a paper in *Revue des Deux Mondes* on the subject, by M. Lamin, it is stated that the forests affected in the Department of Seine-et-Marne have an extent of some 21,000 hectares. The volume of wood broken is estimated at 200,000 steres, the Forest of Fontainebleau alone counting for 150,000 steres. For about fifty years past the Service des Forêts has been seeking to restore the ruined cantons by plantation of Scotch firs. It had thus covered 4000 to 5000 hectares, and every year the woods were carefully thinned for better development. It is now found that these woods of fir have been destroyed in the proportion of sixty to seventy per cent. Some parts, indeed, have been ruined completely. It will be necessary to raze immense portions and commence anew. The work of restoration of the Forest of Fontainebleau has been thrown back thirty years.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences.—Geological Section, April 21st, 1879.—Prof. Arnold Guyot, of Princeton College, presented a paper upon "The Topography of the Catskills," embodying some of the leading points brought out during several years' summer study of these mountains, and now nearly ready for publication. It seems extraordinary that a region like this, in the oldest part of the country as regards settlement, and long celebrated as a resort for travelers, hunters, artists, etc., should have remained so largely an unknown wilderness even to this very day. It was reserved for Prof. Guyot, within a few summers past, actually to discover and name an extensive group of mountains, rising into peaks in some cases over 4000 feet high. This group —the "Southern Catskills," or "Shandakens," was not laid down on any map or described in any gazetteer; and when Prof. Guyot first looked out upon it from a southern height of the main Catskills, he had the surprising experience of a new discovery in the heart of the State of New York. The gazetteers had mentioned it as a hilly country, merely; and the fact that it contains mountains higher than the true Catskills, was new to geographical science. The scantiness of our knowledge regarding all this region --save in the immediate vicinity of the summer resorts—is due largely to the dense forest with which the slopes and summits are clothed, which renders it very difficult to gain connected and extensive views.

Prof. Guyot divides the whole group into two, as already intimated, the true Catskills and the Shandakens or Southern Catskills, separated by the valley of Esopus Creek. From the former flow the Catskill creek into the Hudson, Schoharie Creek into the Mohawk, and numerous affluents of the Upper Delaware; from the latter flow Esopus Creek and Rondout River, into the Hudson, and Neversink River into the Delaware. The mountains exhibit a series of long sub-parallel ranges, trending S.E. and N.W., nearly at right-angles to the general Appalachian course; and this fact, at first, would cause perplexity to the geologist. More careful study, however, removes this apparent anomaly; as these ranges are seen to be simply the result of denudation, excavating an elevated table land; while if a line be drawn from peak to peak of the loftiest summits, it appears that this line will take the N.E. and S.W. course of the Appalachian system. The most prominent summits, which thus mark out the central elevated ridge of the now-excavated plateau, are Black Top, on the northernmost range of the true Catskills, Hunter mountain, on the southern range, and Slide mountain, in the Shandakens, all of which are over 4000 feet high.

Proceedings of the Academy of Natural Sciences of Philadelphia, Feb. 25.—The President, Dr. Ruschenberger, in the Chair. Dr. Goldsmith exhibited some specimens of

Asphaltum from the marl of Vincenttown, N. J., and a peculiar amber from the same source which was considered to be *Krantzite*. Dr. König exhibited his *Chromometer*, an apparatus devised for the purpose of making quantitative analysis of ores by the effect upon beads made by fusion with borax of their complementary colors as seen through red or green prisms of very small divergence.

Microscopical and Biological Section of the Academy, Feb. 3.—Prof. Wm. Barbeck delivered an illustrated lecture on the smuts, rusts and molds injurious to cereal grains.

Feb. 17.—Dr. J. Gibbons Hunt delivered a lecture on the mosses and liverworts.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

PSYCHE.—March. Geographical distribution of North American Coleoptera, by E. P. Austin.

JENAISCHE ZEITSCHRIFT FUR NATURWISSENSCHAFT.—April 15. The comparative anatomy of the digestive system of birds, by H. Gadow; part 1, with eight plates. (Contains many figures of the digestive tract, together with its appendages,of the ratitate and carinate birds, a very useful work).

AMERICAN JOURNAL OF SCIENCE AND ARTS.—May. Experiments in cross-breeding plants of the same variety, by W. J. Beal. Hudson river age of the Taconic schists, etc., by J. D. Dana.

THE GEOLOGICAL MAGAZINE. — May. Notes on Palæozoic Crustacea, by H. Woodward. On Prof. Dana's classification of rocks, by Prof. Bonney. On plagioclinal mountains, by C. Calloway.

AMERICAN GEOGRAPHICAL SOCIETY, May 13.—Mr. A. A. Hayes, Jr., read a paper on modern ocean highways.

June 2.—Mr. J. S. Lamson exhibited specimens of the prehistoric pottery and other antiquities recently procured from graves in Chiriqui, Central America, with some account of the mode of their occurrence.

APPALACHIAN MOUNTAIN CLUB, May 14.—Prof. J. H. Huntington read a paper entitled, From the Forks of the Kennebec to Lake Megantic, and Prof. W. H. Niles explained the use of the Alpine rope.

May 17, there was an excursion to Prospect Hill, Waltham, Mass.

BOSTON SOCIETY OF NATURAL HISTORY, May 7.—Mr. M. E. Wadsworth discussed the classification of rocks, and Dr. T. M. Brewer noticed certain birds of New England.

May 21.—Dr. T. M. Brewer continued his notices of New England birds, and Mr. S. H. Scudder remarked on the earliest cockroaches.

TROY SCIENTIFIC ASSOCIATION, May 19.—Dr. R. H. Ward made an address on mountain vegetation.

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ADJECTIVES OF COLOR IN INDIAN LANGUAGES.

BY ALBERT S. GATSCHET.

SCIENTIFIC inquiry into the cause and frequency of partial and total color-blindness among civilized nations has prompted some naturalists to extend their researches on this deficiency and on the sense of color (the faculty of color perception) over the rude populations inhabiting foreign lands. Inquiries of this order may be considerably helped by publishing all the terms referring to colors found among Asiatic, African, American and Polynesian nations and tribes, and they have been advanced already through careful comparisons of the color adjectives in use among the ancient Greeks and Romans with those of modern European languages.

Indians possess a large number of color adjectives, and the great tendency of their languages to specialize every object observed easily accounts for this. But it often requires a long familiarity with individuals of a tribe to obtain a series of color names approaching to completeness; some of these names are seldom used and therefore not readily remembered even by the most intelligent natives. I therefore resorted to the expedient of composing a scale of colored paper slips insensibly blending into each other; this series was arranged in several groups—gray, blue, green, yellow, red, brown, the end colors being white and black. To prevent confusion by presenting too many color-shades pasted on the same card-board, I have restricted the number of slips to twenty, and this seemed to be sufficient for the purpose. Simultaneously I inquired for the color-shade of certain objects unalterable in their color, as bark of cinnamon, ripe

strawberries, cherries, certain flowers, the yolk of egg, the rainbow and others.

The color series found in Indian languages and in the classic tongues of the ancients differ from ours chiefly by their great lack of *artificial* terms, though even there they are not entirely wanting. The curious and very frequent coincidence of green and yellow, and of blue and green will be considered below.

All Indian terms mentioned in this article are written by means of a scientific alphabet based on European Continental pronunciation.

Of no Indian language have I obtained a more complete color series than of the *Klamath language* of South-western Oregon, spoken by the Modoc and Klamath Lake (or Ḗ-ukshikni) Indians. I present this to students as a fair specimen of the idea of color prevailing among *such* Indian tribes which have but *recently* emerged from the nomadic and hunter state.

No abstract noun exists corresponding to our terms *color, color-shade* or *hue.* But there is a word for the substance used in the dyeing process, which also means dot, stain: shnéluash. It is the verbal noun of shnélua, to stain, to dye, to color, a verb which forms the participle shnéluatko, colored, dyed, and the substantive shneluō'tkish, dye-stuff, coloring matter. Shnélua is etymologically connected with shnélχa, to burn through something, the radix being núta, to burn (v. intr.). Other terms referring to colors and colored articles are: hushkalχanátko, of diversified colors; uyókatko, striped, streaked; shankákash, collar, beads or neckwear of various colors. Three different terms exist for *paint* put on face, arms or body.

For a full comprehension of the terms given below, it is necessary to remember that all the *real* adjectives of the Klamath language, descriptive of surface-quality and color, terminate in –li, and are formed by iterative reduplication, viz: by redoubling of the entire radix without vocalic change. The suffix -ptchi, –tchi means *alike to, similar, resembling;* it forms adjectives from substantives, mostly of a concrete, material signification. The suffix –tko is the sign of a participle, though the verbs, from which participles and verbal adjectives in –tko are derived, have sometimes become obsolete.

No distinction is made between artificial and natural *white;* both are pálpali, pä'lpäli, derived from pála, to dry up, to be exsic-

cated. *Gray* is pākpā'kli, a thematic variation from pā'lpāli, and related to the verb pā'ktgi, "the morning dawns," and to pā'ka, a kind of blanket. Various shades of *gray* are distinguished by these Indians, as lúashptchi, gray as fog (lúash, fog), kāilaptchi, gray as earth, of earthy hue (kāila, ground, dirt, mud); skédshatko, gray, said of rocks, horses, etc.; spúgatko, gray-colored.

The common term for *blue* is mātchmā'tchli, metsmétsli; this is a dark blue, for obsidian arrow-heads are called by this adjective, and it also corresponds to our *purple* and *violet-colored*. Bluish-gray is mākmā'kli, and this word we find also in the generic term for all water birds, ducks, etc.—mā'mākli. A certain shade between blue and purple, applied to a sort of blanket, is tchχe-utchχé-uptchi, a nuance derived from the color of the bluebird, tchχe-utchχé-ush. Another shade of blue is called after a certain kind of beads, yámnashptchi (yámnash, i-ámnash, neckwear) and it is said also of a blue fire-flame.

The common Klamath term for *green* is kākā'kli, suggestive of the light or grassy green. Another green is tolalúptchi, green like the tólalui-blanket, which is manufactured from the tólχash-grass.

The light and golden *yellow* is again kākā'kli. This adjective combines the meanings of light-green and light-yellow, because it stands for the color of any grass, weed or plant, and though the plant passes from the green of spring time and summer into the faded yellow of autumn, the color-name is not changed. But there is another term for the color of the dry leaves in the fall, spálptchi, derived from pála to become dry, spál, yellow earthy paint for the face. The light yellow of metallic gold and the dusky hue of copper are also called kākā'kli, but the *brown* shade of cinnamon is ka-uká-uli, the light-sorrel of horses and the shade seen on pine-burs. A shade darker than this cinnamon hue is tchuitchúili, *buff* or *dark sorrel*. Tchúitchiga means "to be at red or white heat," and tchúitchiks is "strawberry," a fruit called so from its ruddy color.

All the different shades of *red*, as scarlet, incarnate, crimson, carmine and vermilion, are comprehended in the adjective taktákli, while *blonde* (hair) is mákmakli (lák).

The generic term for absence of light is pushpúshli, *black*, which applies also to objects of nature, to complexion, etc. Dim, obscured, dusky-colored is tiptípli; dark-colored, limlímli, the

latter applying also to complexion of the human skin, while both originally referred to the dark hue of clouds. When speaking of night or evening, they use the term tch'múka, "it is dark, obscure."

That certain radicals undergo a slight vocalic or consonantic gradation in many of these color-names to indicate diversity of shade, is obvious. Such changes we observe in metsmétsli, mākmā'kli, mákmakli; in pā'lpāli, pā'kpākli; in kākā'kli and ka-uká-uli.

The idiom of the *Nez-Percés* is spoken by the populous Indian tribe of this name which inhabits the northern part of Idaho Territory. This language was adopted during the course of this century by the Cayuse tribe, on Columbia river, and belongs to the linguistic family of the so called Sahaptin, a Selish term of unknown signification. The other dialects belonging to this family are those of the Warm Springs, Walawála and Yumatilla, in Oregon, the Yákima, Klikatat and Palús, in Washington Territory.

In the Nez-Percé, as well as in the Klamath, the true adjectives of color are formed by reduplication of the monosyllabic radix, in the Nez-Percé, in some instances, even by redoublement of a dissyllabic root.

The term for *white* is also that for clear, transparent (said of *water*) χaiχaiχ, while light-gray, light-cream color is púχpuχ, or páχpaχ. A somewhat darker *gray*, or darker cream, drab or light-yellow is ka-uχká-uχ, also pronounced kā-uχkā'-uχ, ka-uká-u, and used for the metallic shine of silver.

The *blue* shades are all rendered by yúshyush, yúsyus, the light or sky-blue being mā'χkuts yúshyush (mā'χkuts, *light, clear*); the deep-blue, páyu yúshyush. In the same manner are the different shades of *green*, tsiχtsiχ, distinguished from each other, mā'χkuts tsiχtsiχ being bluish-green or pale-greenish. Tsiχtsiχ, for itself, means the green color of grass, and can stand for *grass*.

Another light-yellow, *drab* or cream color is shĕlú-shĕlu wákush (wákush means *resembling, alike to*), a darker shade of it, páyu shĕlúshĕlu; *dun*, as said of horses, is pā'tkuiki, a lighter dun, between the foregoing and kā-uχkā'-uχ, is tako-wákush. Dun-grayish, or mouse-colored, is lakólkoli, while mógsmogs, máχsmaχs is *auburn, sorrel*, and may be said of the yolk of egg, of the brown bear, of blonde hair. The name of the Indian who lately accompanied Chief Joseph on his trip from the Indian Territory to the East, is Tchútli móksmoks, "Yellow Bow."

Lilac is expressed by kúshka mítip, "similar to the mitip berry." This is a berry of lilac color, which grows in a corolla or sort of grape. *Brown*, rusty-brown, deep-brown is shukui-shúkui; *red*, reddish-brown, ilpílp, and this term also serves to express the color of the red cherry, the strawberry and the centifoil rose. *Dark-brown* is pāyu ilpilp, and *black*, timúχtimuχ, when said of black cherries, the black bear, the complexion of the negro, but hiskétse, when used of the darkness of night.

The Indians of this race do not distinguish more than three colors in the rainbow, máχsmaχs, or *yellow*, ilpilp, or *red*, and yúshyush, or *blue*.

The *Kalapúya* race of Indians are the primordial inhabitants of the Willámet valley of North-western Oregon, and within the historical epoch were the masters of about three-quarters of this vast and fertile domain, the remainder being held by the intruding Moláles. They are subdivided into the Atfálati, Yámhill, Lukamáyuk and the Kalapúya proper on the western, the Ahántchuyuk and Sántiam on the eastern side of Willámet river, while the Yónkalla or Ayankē'ld lived on some creeks forming tributaries to Umpqua river. With the exception of the Yónkalla their dialects differ but little, and what is given below is taken from the Atfálati (Tuálati, Wápatu lake) dialect. For more than twenty years hence the Kalapúya tribes have lived in common on Grande Ronde reservation, Yamhill and Polk counties, Oregon.

In this language adjectives are always connected with some pronominal or predicative prefix, which I have retrenched in these quotations.

White is mó-u; *gray*, plótim; *blue*, pé-i ánkaf pawé-u; *purple*, túlĕlu; *green*, tónktĕχo.

Yellow, pé-i ántk pawé-u; *sorrel*, liblo, a term borrowed from Chinook jargon; *roan-colored*, sándĕli; *brown*, pû'dshnank túlĕlu, "not quite purple;" *red*, tchál, tchéllim.

Of metallic or *golden shine* or *color*, wéltchiām; *multicolored*, of diversified colors, yā'mtchei; *black*, móyim.

The real meaning of these names could not be disclosed, since the intricate phonetics of this linguistic family render etymological inquiries singularly difficult. We cannot draw any other inference from this list, as it stands now, but that the colors seem as well specified as in English, and that only blue and yellow show close resemblance or identity in their names.

The *Michópdo* Indians of the Maidu race of Northern California, east of Sacramento river, live in a small settlement on the outskirts of the town of Chico. They call themselves Otakímma, because they dwell on the banks of Ótakim shéwi, their name for Chico creek, a small tributary of Sacramento river. Their dialect differs but little from that of the Eskenímma, or Indians on Butte creek, seven miles south of Chico, near Durham town.

The adjectives composing their list of color names begin in e- and end in -i, and the majority is trisyllabic:

white, ékoko, said of natural and artificial white.
gray, épupi; gray beads, épupi gúya.
blue, époti, sky-blue, purple and blue with a yellowish tinge; épotim pápaga, the yolk of egg.
green, ébali; green beads, ébali gúya.
yellow, edsíshi, edsíssi: brown, roan, dark-sorrel, buff, of metallic shine, edshíshim peso, gold, gold dollar, lit. "yellow dollar."
color of blue-tailed deer, esíwiti; blue-tailed deer, esíwitim búku.
color of black-tailed deer, émuli; black-tailed deer, émulim búku.
black, ekíli; also dusky, dark complexioned.
red, épapi; said of flowers, ants, beads, etc.
striped in colors, etü'düti; animals, etc.
dark, dusky, kaísiki; said of night.
light, clear, yokáki; said of daylight.

In this list we perceive that the term for blue gradually passes into that of yellow, and that of yellow into brown.

Like other Indians the *Dakota* race possesses a very complete scale of color names in its sonorous idioms. The dictionary of Rev. Stephen R. Riggs has furnished the terms of the subdialect of the Santee-Sioux, and the language of the other Sioux tribes differs but very little from it. I have rendered Riggs' pointed h by χ, and the nasal n, which is heard in the French *bon*, *loin*, *reins* by ng. All the principal color names possess a reduplicated form to mark intensity, and form denominative verbs.

No abstract term for our word *color* exists, though there is one for *to paint*, owa, and others for *dyeing* and *painting* in any of the principal colors.

White is rendered by ska, to whiten by skaya, while sang means whitish, yellowish, brown, and ska also possesses the meaning of clear, transparent. The terms for *gray* designate a

mixture of black upon a white ground, or black mixed with white, as is visible in the skin of the badger, χa, oχa, oχaka; χota means not only gray but also brown, like sang (sangyang, to make brown or whitish). *Brown* is also expressed by gi, when it is a dark gray or rusty-looking brown; its reduplicated form, gigi, meaning *rust* and *brown, rusty*; gitká, brownish; gitkádang, a little brownish; gitkátka, reddish, brownish, yellowish. The g in all these words is a deep sonant guttural.

To, reduplicated toto, is *blue* and *green*, and all the intermediate shades; to color, dye, blue or green, tóya; blue and green beads, totódang. Purple, grape-colored is stang; purple, stangka; ha stáng, dark complexioned (ha meaning *skin*); shástang, dark red, literally "red-purple."

Yellow is zi; to dye or color yellow, ziya; the reddish-gray squirrel, zitchá. *Light red* is distinguished in this color by a separate term, sha, from *dark red* or scarlet, crimson; duta, which can also be rendered by sha χingtcha, or by deep, intensive red, shashá; to dye red is sháya, shasháya, and vermilion color or red paint is washé-sha; wasé being "red earth."

Dark is tpaza; darkness, to be dark, okpaza, otpaza. *Black* is sápa; deep black, sapsápa; to blacken, samyá; dark or blackish, samyáhan.

The words for whitish, red and black, sang, sha, sapa, seem to have been formed from the same radix, and this may be said also of the terms for white and black in the Atfálati-Kalapúya.

The *Sháwano* or *Shawnee* tribe forms a branch of the widespread Algónkin race of Eastern Indians, which is so intimately connected with the early history of the Colonies of North America. As their name indicates, they once belonged to the southernmost tribes of that family, and are now settled to the number of about seven hundred individuals in the north-eastern portion of the Indian Territory.

They have special terms for each kind of *body paint*, f. i., hú'lamu, red paint, which was the war paint, but no abstract term for *color*. I paint myself is netasathú, and the paint, hat'thika.

White is waχkanagiá; *transparent*, sápune. *Gray* is wipegua, and this may be modified, like any other color, by the adverbs pkúni wibegua, *dark gray*, and hálawe wipegua, *light gray*. For *blue* and *green* only one term, skipagia, exists, this being used, for instance, of the color of the sky. *Yellow* is hutháwa; *red*

mskuáwi; *bronze colored* hálawi mskuáwi (lit. "light red"); *brown*, pkúni mskuáwi, or dark red, while the red cockscomb is mskuá pelué. No special term exists for *buff* color. *Black* is mkatéwa, and *opaque* is circumscribed by "you cannot see through." Objects *reflecting* sunlight are called wasétе; multicolored, tsági yelatégi, and striped in colors, lalatasáte, when the stripes run in a vertical direction.

The *Creek* language is one of the dialects of the Maskōki linguistic family, once the form of speech dominant in the territories of the Gulf States. The languages forming this stock have, in course of time, differentiated so much among themselves that they have become incomprehensible to each other. The principal dialects, as far as known to us, are Chá'hta with Chikasa; Creek (upper and lower) with Seminole; Natchez; Hitchiti; Apalache. Nothing certain is known concerning the Alibámu dialect, which is still spoken in one of the south-eastern counties of Texas. Besides a few Indians remaining in Texas and in the Everglades of Florida, all the natives speaking Maskōki dialects are now settled in the Indian Territory.

The phonetic character of all these idioms pleasantly affects the ear accustomed to European languages. All of them, the Creek not excepted, possess the lingual *ɬ*, which could be rendered by *thl*, a group of sounds approaching closely to its real articulation.

The term for *white* and *clear* is hátgi, and since every adjective of color forms an attributive verb, *he is white* is hátgis. From hátgi is derived supák'hatgi, *gray* and *roan*, literally, "mixed in with white."

Blue is holáti, oχoláti, which may be said of the sky, of water, of distant mountains; wiwat hulátis, the water is blue. *Green* is láni, and when said of plants it means "not in a dry state;" pahilánoma, grass-green; páhit lánis, however, means as well, "the grass is green," as "the grass is faded, yellow;" láni also means *bile*.

The term for *red*, tcháti, also means "blood," and forms the derivate oktsádi, *purple* (and *sorrel* when applied to horses).

Hásti, *black*, forms the derivate okulóshti, *brown; dark*, when used for the darkness of night, is yĕmúdshki.

Instead of inventing new terms for metals recently imported, as a few tribes have done, the Creeks will call gold coin, "yellow

iron beads," tchătu χónap láni; silver coin, "white iron beads," tchătu χónap hátgi; sulphur or brimstone is to them, "yellow gunpowder," tĕhótop láni; copper, brass and bronze, "yellow iron," tchátu láni; alum, "sour iron," tchătu kamúksi.

In the present article I have rejected all information that was not circumstantial and entirely reliable. In six languages I have relied on oral information gathered by myself, while for the Santee-Dakota, the words mentioned were extracted from Riggs' Dictionary. To draw *general* conclusions upon the subject of color nomenclature and the Indian perception of color from the few instances given here would certainly be precocious. Indian tribes show considerable difference from each other in habits, customs, intellectual power, not less than in their bodily qualities and in language. Hence very few general ethnological truths can be uttered about them that will really apply to them all.

The following *conclusions* are, therefore, intended to apply *only to the seven idioms referred to:*

1. In the lists of colors submitted we find that the Indians in question distinguish as many, if not more *shades* of color, as we do, if we exclude the large number of our artificial color-names, as ultramarine, isabelle, solferino, etc.

2. No generic term for our word *color* exists, and it seems that such a term is too abstract for their conception. But they have terms for coloring matter, dye-stuff, paint, and for our participles "colored," "dyed," "painted" and "tinged."

3. Many of their colors, even the most opposite ones, are derived from one and the same radical syllable. Instances were given under Klamath, Kalapuya, Dakota. The same may be observed when we compare our blank, blue, black and the German bleich (livid, pale); gray and green.

4. In the Indian lists we observe some names of medley or mixed colors, which impress the eye by being not homogeneous. Such is the Klamath mă'kmăkli, which is the blue mixed with gray, as observed on wild geese and ducks; tchχe-utchχé-uptchi, the mixed color of the bluejay; and gray, in most of the dialects, means black mixed in with white, or white with black, as observed in the fur of the racoon, gray fox and other wild beasts.

5. In naming some colors Indians follow another principle than we do, in qualifying certain objects of nature by their color and then calling them by the same attribute, even when their color

has been altered.[1] This we distinctly observe in kăkă'kli, *yellow* and *green* in Klamath, the adjective having been given originally to the color of grass, trees or other plants. The same is observed in the Niskualli language of Washington Territory, in which both colors are called hókwats, and we may assume that this is the light and not the dark shade of yellow and green.

Most frequently *blue* and *green* are rendered by one and the same term, as in Dakota, Sháwano and in Maya (yáash). Other Indian dialects which are reported to have the same name for both colors are the Chokóyem, north of San Francisco bay: sivita; the dialect of the Yákimas and Warm Spring Indians of Sahaptin family, lómĕt, lă'mt; the Shásti, itchumpaχé; the Guarani, tobi; and the Muyskas near Bogotá, chiskuiko, the latter belonging both to South America. Among the Paí-Uta, the Uta, Pomo, the Wintún and the Tinné-Apaches, the terms for both colors seem to be identical also. Unfortunately we are not acquainted with the etymology of all these terms, unless we would probably be enabled to prove that the real cause of this curious coincidence is another than color-blindness.

Blue and *purple* is called by the same name in Klamath and in the Michópdo dialect of Maidu.

Red and *yellow*, or *yellow* and *brown*, or *brown* and *red* are sometimes expressed by the same term, but *only when yellow* and *blue* are called *differently*. I have never met with a dialect which called black and dark blue, or black and dark green by the same adjective, though this is reported to be the case among the Niskualli, the Ta'hkali of British Columbia, and several other tribes.

6. As I have stated above, Indians often follow principles differing from ours in naming colors. The Klamath language has two terms for green, one when applied to the color of the vegetals (kakă'kli), another when applied to garments and dress (tolalúptchi). Blue when said of beads is again another word than blue in flowers and blue in garments. Thus may be explained the fact that some investigators have found the adjective *black* attributed to objects of a dark-blue or dark-green color. The Dakotas have three terms for brown, gi, sang and χota, each of them being applied to objects of different classes. Even in

[1] Thus the name applied to the color of a quadruped may remain even when the animal has changed its color through the change of seasons.

English we use different terms when speaking of the darkness of night and the black of a dress; or of the blonde hair and the yellowish-white corresponding color of other objects striking our eye-sight. The occasional existence of more than one term for *one* color for the reason just alluded to is observed in the languages of every portion of the globe. Curiously enough the *red* color is not often diversified into different shades in the languages considered; in Spanish it is colorado, "showing color;" this evidently means that red is the color striking our eye with the greatest intensity.

7. Reduplication of the radix is very often met with in color names, but the cause of this is not always the same. In Klamath and the Sahaptin dialects it is distribution and repetition, in Dakota it is the idea of intensity that has produced this synthetic feature.

We think the inquiry into the color-sense and that into the color-blindness among the individuals of a people must be kept distinct from each other. It is premature to assume that a whole people can be color-blind, though its color nomenclature may largely differ from ours, but it is by no means improbable that color-blindness is more frequent among hunting and nomadic nations than among individuals of civilized races. This question can be decided by direct experimental observation only, while in the inquiry concerning color-sense, the science of linguistics is entitled to take part in the discussion.

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THE HABITS OF A TARANTULA.

BY MRS. MARY TREAT.

FOR the past year I have been observing a large burrowing spider belonging to the family of Lycosidæ. Its habits and probably the creature itself, had entirely escaped the attention of naturalists until recently. Its habitat is in Southern New Jersey. In the grove which surrounds the house where my observations were made, are many burrowing spiders which build open tubes lined with a web of silk, and a projecting rim of sticks and leaves are firmly held together with web to keep the sand and *debris* from falling into the nest.

Last summer (1878), I accidentally found a covered tube, perfectly concealed, which aroused my curiosity sufficiently to keep

close watch of the occupant. I did not pay much attention to the open-mouthed tubes for some time, as I supposed the occupants to be a distinct species from the one which covered the tube.

In July of last summer the Rev. Dr. McCook, of Philadelphia, the distinguished myrmecologist, upon invitation, visited my colony of slave-making ants (*Formica sanguinea*), and while on this visit I called his attention to the burrowing spider with the open tubes. After his return home he wrote me that he thought the spider a new species which he had provisionally named *Tarentula tigrina*,[1] or the tiger spider. But the spider with the covered tube was of so much more account that I still paid no attention to this one which lived in the open burrow! But I am now convinced, after a year's observation, that what I supposed to be two distinct species are but one. The young scarcely ever conceal their tubes.

A brief account of one individual spider will, perhaps, give a clearer idea of this species than any attempt at a learned disquisition. A large female has her home in a bed of moss beneath an oak tree, only a few feet from the house. Her body is nearly black and quite hairy, the legs are gray and black, striped after the fashion of a tiger. When I first observed her the tube was only partially covered, the cover projecting above it like a hood or top of a baby carriage. When not disturbed, she usually stood at the door of her home waiting for any chance insect which she might spring upon.

My visits to her were very frequent, and for several days upon my approach she would suddenly disappear within her den, but finally she seemed to become accustomed to these visits and would allow me to sit near her, keeping her position at the door. I supplied her with water, of which she would take long draughts. I also placed sugar near her door to attract the flies. She would stand perfectly motionless, watching the eager insects, until she fixed her eyes upon one that suited her taste when she sprang upon it like a flash, and disappeared within her den to make her meal. This kind of life continued for several weeks—simply watching for prey and eating. But in August another phase in her life was made manifest. A male was attracted to her cozy quarters. He does not look at all like the female, is of an entirely

[1] Proceedings of the American Entomological Society, 1878.

different color—yellowish with dashes of dark brown—his body is smaller than hers though his legs are longer.

In August the males are abundant. I often see them bounding over grass and weeds, making long strides, fairly flying before me. At such times it is next to an impossibility to capture one. I have not been able to ascertain whether he has a settled home like the female, which he leaves to make amorous visits, or whether he always leads a vagrant kind of life.

He approaches the female with the utmost caution. If she is within her den he stands at the door, sometimes hours together; nothing will induce him to venture within, and he is wonderfully oblivious of my presence. I cannot push him in, he will back out into my hand rather than be driven into the burrow. Now the female slowly advances to meet him, and he slowly retreats from the mouth of the den, moving backward while she moves forward, just reaching him with the tips of her fore-legs as if caressing him. She follows him in this way a foot or more, then leaves him and quickly returns to her den, he follows her to the door, where he keeps his post until she again comes forth, when the same performance is repeated.

I leave them, and on my next visit I find the male on the back of the female, with their heads both within the burrow and their long hind-legs sticking out. (This is not the position the spider assumes when he fertilizes the eggs, which is done by means of the palpal organs, necessitating the opposite direction of the head.) They now remain perfectly still, and I pick them up by their legs and drop them into a wide-mouthed glass bottle. This displaces the male, and he crouches down in a helpless sort of way as if paralyzed with fear, not trying to make his escape at all. For a few moments the female pays no attention to him but makes vigorous efforts to escape. Soon, however, she pounces upon him, seizing him on the under side of the head—literally by the throat. He makes but feeble efforts of resistance, in fact, acts as if he rather enjoyed being eaten! I shake the bottle but she will not let go her hold. She soon makes him into a ball which she holds and sucks, seemingly with great relish. I now place the open bottle by the mouth of her den and she quickly disappears, taking with her the remains of her lover. In a day or two after this another male was at her door behaving in a similar manner. I did not interfere with his movements, and do not know his fate.

After a few days the female resumed her old habits, watching for prey, and became so tame that she would take water from my hand. She made but little change to the partial cover of her tube until November, then it was cut down and made flat to the ground—perfectly concealed with leaves and moss and held firmly down with a strong web. This cover remained until the following April. I was waiting to see what the occupant would do, when an accident occurred. I was absent when the leaves were raked up, and the man, not observing my protection, raked all away. But in a few days thereafter the spider made another cover, entirely unlike the winter one, more like a little room. The nest is situated in a bed of green moss, and the cover looks like a little oval mound of moss and leaves. The longest diameter measures five inches over, and the shortest, four and a half inches. The base of the cover is made of acorn cups and sticks firmly held together with strands of silk, then a canopy of web is made, and over this is laid green moss, dry pine needles, bits of dry oak leaves and light sticks held fast with web. This makes a neat little upper room, the walls are smooth on the inside but rough outside. She leaves a window in the room, the object of which is apparent. She has a cocoon of eggs attached to the spinneret, and she puts herself in position to let the cocoon rest against the window where it receives the rays of the sun. For three weeks this has been her daily occupation—patiently holding the eggs in the sun.

On the 20th of May I took the cover from the tube and after it was removed it was some hours before I saw her, but toward evening she reached out with her hind-legs; feeling for material, she first

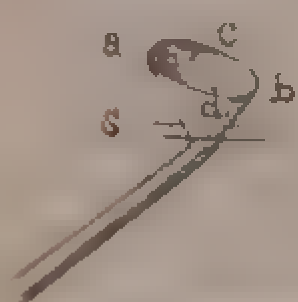

FIG. 1.—*s*, surface of ground; *a b c d*, silk lined tunnel.

FIG. 2.—Nest of *Tarantula* [illegible] (

drew in an acorn cup and proceeded to fasten it. How it was

done I cannot tell, for the cocoon of eggs seem to be attached to the spinneret. On the following morning a broad funnel-shaped rim was built around the tube but not yet covered; by the 24th she has made a room lightly covered with moss.

Rev. Dr. McCook kindly furnished cuts of the nest with the open funnel. I append his description, which was published in the Proceedings of the Academy of Natural Sciences of Philadelphia: "The tube is about seven and one-half inches deep, resembling an ear-trumpet (Fig. 1), with the mouth upward. It is bent at an angle of 60° shortly below the surface; the upper part is a silk-lined funnel that widens outwardly to the margin which at the highest point is one and one-eighth inches above the surface of the ground. The silken lining extends but a little way below the surface. The projecting funnel is composed of blades of grass (Fig. 2), which are bent down upon their stalks from all sides, overlaid, and rudely interwoven, making thus a background upon which the smooth silken lining is placed. The longest diameter of the mouth of the tube (Fig. 1), *ab*, is one and one half inches, the shorter diameter *cd*, is one and one-quarter inches. The diameter of the tunnel below the surface is five-eighths of an inch."

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THE FORMATION OF CAPE COD.[1]

BY WARREN UPHAM.

THE peninsula of Cape Cod, called by Thoreau the "bended arm of Massachusetts," the Elizabeth islands, which are a continuation from it to the south-west, and Martha's Vineyard and Nantucket on the south, are recent additions to the territory of New England. They contain no ledges of solid rock, but are made up of the ruins and detritus of ledges which have been broken and pulverized. This has been done by decomposition under the influence of frosts and rains, by the excavations of

[1] A previous description of this region, based on observations made in a hasty journey for comparison of its drift deposits with those found in New Hampshire, was presented a year ago in the Geological Report of that State, Vol. III, pp. 300–305. Since that time the writer has been over this field more leisurely, spending several months in amateur exploration from Cape Cod and Nantucket westward to New Jersey. This has brought a more correct knowledge of the facts, especially in respect to the course, in South-eastern Massachusetts, of the series of hills here called terminal moraines; as well as some changes in opinions, one of these being in respect to the probable height of the sea here when these deposits were accumulated.

streams, and at the last by glacial erosion. Materials have been thus gathered and mixed from sources near and remote. Their deposition, excepting the Tertiary beds of Martha's Vineyard, appears to have taken place during the Quaternary period, partly before the ice-sheet was extended over this region, partly along its terminal front in long series of morainic hills bordered on the south by sloping plains of gravel and sand, and partly by immense floods poured down from the surface of the melting ice-fields during their retreat.

Since the glacial theory of the origin of the drift was brought to the attention of geologists by Agassiz, forty years ago, it has been closely compared with all the observed facts, and seems to afford for them an adequate and complete explanation. It has received the highest kind of testimony to its truth in being required to explain new discoveries and to answer questions which were not thought of when the theory was announced. The glaciers of Switzerland were found to furrow, scratch and polish the bed-rock over which they move, rounding and planing away its projecting points, just as the ledges of all northern countries are striated, rounded and worn smooth. This is done by the grating of boulders and gravel frozen in the bottom of the ice; and the sides of these stones are, of course, planed and striated the same as the underlying rock. In the valleys of the Alps are many glaciers ten to twenty miles long, and through this whole distance rock-fragments are dropped on them from bordering cliffs, brought in by tributaries and wrenched from the ledges beneath; so that diverse kinds, some of them derived from its farthest sources, become mingled both at the top and bottom of the ice. Corresponding to this transportation, grinding and mixture of materials effected by the glaciers, there was found over the surface of all regions which had striated ledges a most remarkable deposit of boulders gathered from distant and diverse sources, indiscriminately mixed with gravel, sand and clay. Many of these blocks and pebbles have their sides worn flat and marked with striæ, and were evidently the agents by which the ledges were similarly eroded and marked. This deposit, called unmodified drift or till, differs from any made by rivers, lakes or the sea, in showing no evidence of the assorting and stratifying action of water. To account for its formation and for the accompanying striæ on the ledges, it was supposed that a mantle of solid ice was accumulated

over these areas, and that it moved slowly in the direction of the striation, ploughing up, transporting, grinding and mixing together the materials of the till, and leaving its track and course clearly marked upon the bed-rock.

Cape Cod is mainly composed of another formation, called modified drift, because it has been transported, worn and deposited by currents of water. Gravel, sand and clay are separated in distinct layers and beds, instead of being mingled in one mass. Most portions are entirely destitute of any large boulders, and the pebbles of the gravel are rounded, instead of the planed or else rough and unworn forms which they have in the till. The modified drift is found in the valleys or upon the nearly level tracts of glaciated regions, and follows lines of drainage which reach beyond these limits. Formerly it was the prevailing opinion that this formation was gradually produced from the unmodified glacial drift by the ordinary action of rains, streams and the sea. Further observation, however, seems to leave no doubt that it originated from the ice-sheet, and was rapidly deposited during its retreat. This had taken up in its lower portion not only boulders of every size, but also great quantities of decomposed rock, which covered the hills and plains and had been swept into thick deposits in the valleys before the glacial period. The rivers formed by its melting gathered such of these materials as they could transport, turned the blocks and pebbles over and over in their descent till they were made round and smooth, and deposited their freight in these beds of gravel, sand and clay. The modified drift of South-eastern Massachusetts, here to be described, appears to add much to our knowledge of these conditions attending the departure of the ice-sheet.

Another subject of great interest is presented on Cape Cod and the Elizabeth islands in a series of drift-hills, which appear to have been formed at the margin of the ice during a pause in its retreat, when, perhaps after some re-advance, it halted and preserved its termination nearly stationary through a long period. This series consists of very irregular hills, mounds, ridges and enclosed hollows, and is composed partly of till, with abundant boulders and no marks of stratification, and partly of stratified gravel and sand with boulders few or rare. That it does not indicate the extreme limit of glacial action is shown by the occurrence of a similar belt of hills on Martha's Vineyard and

Nantucket islands, from five to thirty miles farther south. A comparison of these with similar ranges of hills in Rhode Island, Long Island and New Jersey, which seem to be same series continued farther to the west, will enable us more fully to understand the meaning of these deposits.

The most noticeable product of a glacier is its terminal moraine, or the heaps and ridges of detritus which it brings down and pushes out at its end, when this remains at nearly the same place through a long succession of years. Slight advances and retreats often give these deposits a most broken surface of alternating hillocks and depressions, and in many cases they are partly composed of stratified gravel and sand, brought by streams during the meltings of summer. The great ice-sheets of the glacial period acted in the same way, and within a few years geologists have recognized the terminal moraines of that which overspread the Northern United States and British America. Across New Jersey[1] and upon Long Island[2] its outmost border is definitely marked by a continuous series of drift-hills, one hundred and seventy-five miles in extent. Striæ, till and boulders are confined to the region north of this line. From the Narrows to Montauk point this moraine is commonly known as the "backbone of Long Island," and consists of hills which vary from one hundred and fifty to three hundred and eighty-four feet in height. The west portion of this range, reaching from Fort Hamilton, by Greenwood cemetery, Prospect park and Ridgewood reservoir, to Roslyn, a distance of twenty-five miles, is mainly an unstratified deposit, like the loose, oxidized, angular upper till which forms the surface generally through New York and New England. From Roslyn, through the middle and east portions of the island, nearly all of these hills, including the highest elevations in the range, are composed of modified drift, being gravel and sand distinctly stratified and containing few or rare boulders. The part of Long Island south of these hills consists of gently sloping plains of fine gravel and sand, five to ten miles in width, and extending a hundred miles in length. The height of their upper margin at the foot of the hills varies from fifty to one hundred

[1] Annual Report of the Geological Survey of New Jersey for the year 1877, pp. 9–22, with map.

[2] This series of hills on Long Island was well described by Mather in the Geological Report of the First District of New York, in 1843, shortly after the theory of continental ice-sheets was proposed.

and fifty feet above the sea. Another long series of plains, varying from one mile to five miles in width, and of similar height and southward slope with the foregoing, extends on the north side of these hills from Syosset forty-five miles eastward to Riverhead, and thence continues along the north branch of the island nearly thirty miles more to Orient point. North of these plains, along the whole extent of shore east from Port Jefferson, is another series of drift-hills which rise one hundred to two hundred feet above the sea, by which their northern side has been frequently washed away. This second moraine is also mainly composed of stratified gravel and sand with few boulders; but in the vicinity of Greenport and Orient its material is changed to a very coarse unstratified deposit like the upper till. This series is very plainly continued north eastward in Plum and Fisher's islands, which are made up of hills of glacial drift like those near Greenport, with small areas of level modified-drift at their south side. Thence it passes into Rhode Island at its south-west corner, and extends close to the coast seventeen miles from Watch Hill nearly to Point Judith, being very finely developed in a belt which varies from one-half mile to one and a-half miles in width, composed of coarsely rocky drift in hills and ridges one hundred to one hundred and fifty feet high. About two miles north-west from Point Judith this range sinks to the sea-level, and its further continuation is lost, probably because it turns southward into the ocean. Twelve miles to the south the continuation of the first range is lifted into view in Block island, a knot of very irregular drift-hills, which resemble those of Montauk in being composed of coarse gravel, sand and clay, distinctly stratified but often enclosing numerous boulders. We have thus two long parallel series of drift-hills, the most southern of them at the boundary of the glacial drift. Both appear to be terminal moraines of the ice-sheet, having been formed along its border, the southern range at its period of greatest extent, and the northern at some later time during which it halted in its departure.

The sea covers the next thirty miles in the line of continuation of these series of hills, beyond which both of them rise above its waves again, the northern forming the Elizabeth islands, and bending to the north-east and north on the peninsula of Cape Cod to near North Sandwich, where it turns at a right angle, and thence runs to the east through Barnstable and the other towns to Orleans,

traversing the west-to-east portion of the cape, and extending into the ocean at its east shore. The southern moraine, marking the farthest bound reached by the ice, forms No Man's Land, the crest of Gay Head, and prominent ranges of hills in the north-western part of Martha's Vineyard, extending north-east nearly to Vineyard Haven. Here this series apparently bends to the south-east, somewhat as the northern range turns at North Sandwich, but it is concealed beneath plains or the sea for much of the way beyond this point. It appears unmistakably, however, on Chappaquiddick and Tuckernuck islands, and in Saul's hills and Sankaty Head on Nantucket. The length of the northern moraine from the east shore of Cape Cod to the west end of the Elizabeth islands is sixty-seven miles, while its total length to Port Jefferson, on Long Island, is about one hundred and eighty miles. That of the southern moraine, in its course from Sankaty Head to No Man's Land, is fifty miles, and its whole extent as yet traced, to the west line of New Jersey, is about three hundred miles.

On the islands south of Cape Cod these hills have the following heights in feet above the sea: No Man's Land about one hundred and fifty; Gay Head one hundred to one hundred and forty-five; about one mile east, near the church, one hundred and eighty-five; Prospect hill, the highest on Martha's Vineyard, two hundred and ninety-five; Peaked hill, a mile south from the last, two hundred and ninety; other hills, reaching from these five miles to the north-east, two hundred to two hundred and fifty; Indian hill, two hundred and forty-five; Sampson's hill, on Chappaquiddick island, about one hundred; highest part of Tuckernuck, about fifty; Macy's or Pole hill, the highest of Saul's hills, ninety-one; Folger's hill, a mile east from the last, eighty-eight, and Sankaty Head, the highest point of Nantucket island, one hundred and five. The cliffs of Gay Head, at the west end of Martha's Vineyard, expose a section four-fifths of a mile long, composed at the top of the unstratified terminal moraine five to forty feet thick, filled with abundant boulders of all sizes, up to twenty feet in diameter. This rests on fossiliferous Tertiary beds,[1] probably of Miocene age, which dip from 20° to 50° northerly throughout the section, and present a most striking succession of brightly-

[1] Described in Hitchcock's Geology of Massachusetts, 1833 and 1841; and in Lyell's Travels in North America in 1841-2, Vol. 1, pp. 203–206.

colored clays, sand and gravel, varying from black to red, brown, gray and white. Gay Head township, reaching three miles to the east, has a very uneven surface of glacial drift in small elevations and depressions, strown with frequent boulders but apparently underlain by Tertiary clay and sand at no great depth. The parallel ranges of hills which extend through Chilmark and the north-west part of Tisbury, occupying a width of one to three miles, have also a very irregular contour. Their surface is generally glacial drift with very abundant boulders, but occasionally, as at the top of Prospect hill, it is modified, consisting mainly of water-worn gravel and sand. The black, red and white Tertiary clays underlie these deposits in the hills, and are exposed in the cliffs along the north-western shore to the east side of Lumbard's cove, eleven miles from Gay Head. Upon the south side of Prospect and Peaked hills they extend to heights two hundred and twenty-five and two hundred and fifty feet above the sea.

The south-eastern half of Martha's Vineyard consists of modified drift without boulders, lying in extensive level plains twenty-five to fifty or sixty feet above the sea. Along the south shore these plains are indented by numerous ponds, which are only separated from the ocean by a beach, and the shores of the ponds are again indented by long and narrow arms or coves, from the head of which dry channels extend across the plains in a northerly course. The road from West Tisbury to Edgartown crosses several of these depressions, one of which, known as Quampachy hollow, may be taken as an example; this starts from the head of Oyster pond, a narrow arm of the sea which stretches two miles north from the beach by which it is now shut in. The dry hollow, diminishing from twenty-five to ten feet in depth and from three hundred to one hundred feet in width, prolongs this valley at least three miles to the north. Near Vineyard Haven and Oak Bluffs, north of these plains, and on Chappaquiddick island, the modified drift, sometimes sprinkled with boulders, is heaped in gently-sloping hills fifty to one hundred feet high, which appear to have been formed at the margin of the ice-sheet. Thence the line of terminal moraine is continued in Muskeget and Gravelly islands, which, however, are only low banks of gravel and sand. On Tuckernuck island it appears again in small hills, which in part, as seen at North pond and eastward, are unstratified, with plenty of boulders, the remainder being modified drift.

Nantucket is almost wholly composed of stratified gravel and sand. Along the whole south side of the island, from Long pond to Tom Never's Head, these lie in nearly level plains, twenty to sixty feet above the sea. This expanse, reaching more than ten miles from west to east, with a width varying from one to three miles, is broken by frequent hollows which extend approximately from north to south like those already noticed on Martha's Vineyard. Narrow ponds, of the same height as the ocean, fill the entire course of these depressions, or occupy their lower end next to the beach. All the ponds along the south shore are of this class, including Long, Hummock, Miacomet, Weweeder, Nobadeer, Madequecham, Wigwam and Forked ponds, with several others of smaller size. The line at which the ice-sheet appears to have terminated is marked in the west part of the island by gently undulating hills, forty to fifty feet high, composed of stratified drift, which, however, differs from that of the plains in having here and there boulders up to ten feet in diameter embedded in it or lying on the surface. The course of this line is from Eel point, north of Maddequet harbor, by Trot's hills, to the town. Eastward it continues on the same course in the Shawkemo hills and Saul's hills to Sankaty Head. The portion of this series called Saul's hills, two miles long and a half mile wide, is of very irregular contour, with steep and abruptly-changing slopes, forming hills, ridges, mounds and small enclosed basins, some of which contain ponds. The material is stratified gravel and sand, upon and in which are scattered boulders, varying up to ten feet in diameter.

Sankaty Head, at the east shore of the island, affords a section across this range.[1] A quarter of a mile south from the lighthouse, the order of deposits, beginning at the base, is as follows: brown sandy clay to about twenty feet above the sea; ferruginous sand and gravel, four feet; white sand, four feet; yellow sand, enclosing masses of blue clay, one foot; ferruginous gravel and sand, with abundant shells, two feet; a bed of Serpulæ mixed with sand, about two feet; gravel and sand again, thickly filled with shells, two feet; fine white sand, about ten feet; the common yellow sand and fine gravel of the modified drift, about forty-five feet, its top being at ninety feet;

[1] The Post-pliocene beds at the base of this section, and their fossils, are fully described by Prof. A. E. Verrill and Mr. S. H. Scudder, in the *American Journal of Science and Arts*, 3d series, Vol. x, pp. 364–375.

coarse gravel, three feet; ferruginous sand, one foot, changing above into a former surface soil one foot thick; overlain by three feet of dune sand, which forms the present surface ninety-eight feet above the sea. The highest part of the bank is midway between this point and the light-house. On each side of the section here noted the shell-beds gradually thin out and disappear at a distance of about forty feet. The bed below the layer of Serpulæ contains about thirty-five species, which make up a faunal group of distinctly southern character, all of them being now found living on the southern shores of New England, but several having their northern limit at Cape Cod. The species of Serpula is also of southern range, reaching from this limit to North Carolina. The upper shell-bed has about the same number of species as the lower, but only thirteen are common to both. The new species brought in by the upper bed are mostly of northern range; though all of these are found as far south as Massachusetts bay, several of them have their southern limit here or on the south coast of New England. From a comparison of these groups, Prof. Verrill estimates that the average temperature of the sea at this place had been lowered 15° between the times in which they lived. The layer of coarse gravel which occurs here at the height of ninety feet, is continuous for a half mile from this point, both to the north and south, varying from three to eight feet in thickness. About half of its rock-fragments are rounded, these being of all sizes up to one foot through; the rest, which are rough and angular, range up to two feet and rarely to four feet in diameter. This bed has its greatest thickness and is coarsest at the highest portion of the bluff, where it closely resembles till. The old surface of black soil and the present surface of dune sand are also continuous along the same distance, the latter at the light-house and northward being one and a half feet thick. An eighth of a mile south from the shell-beds the bluff falls to a hollow about sixty feet above the sea, and in this depression the blackened layer becomes a bed of peat two feet thick, containing numerous stumps and roots of trees and covered by two feet of sand. The rocky stratum, the old surface soil and the overlying sand cap the bluff for more than a mile, in which its height falls from one hundred and five feet at the middle to about thirty-five feet at each end. Below the rocky layer it consists of fine modified drift and pre-glacial beds. The his-

tory of this section reaches from a period when the sea had about its present temperature; next it becomes much colder; sand and fine gravel are accumulated to a depth of more than fifty feet, probably brought by rivers from the summer meltings of the ice-sheet; this finally reached its outmost limit, overspreading the north half of the island; at its retreat the coarser materials which it held were dropped; forests sprang up as the climate became mild again; and lastly, the sea has eaten away the east portion of these deposits, while the sand of its shore has been swept by the wind over their top.

Heights of the later terminal moraine, on the Elizabeth islands and Cape Cod, are as follows; highest portions of Cuttyhunk, Nashawena, Pasque and Naushon islands, about one hundred and seventy-five feet above the sea; the Quisset hills, west of Falmouth village, about one hundred and fifty; station of the U. S. Coast Survey, one mile east of West Falmouth, one hundred and ninety-eight; the Ridge hills, extending thence to the angle of this series near North Sandwich, one of them being called Pine hill on the State map, one hundred and fifty to two hundred feet; south-west from Sandwich village, about two hundred and twenty-five; Bourne's hill, a Coast Survey station two miles south-south-east from Sandwich, the highest point of the whole series, two hundred and ninety-seven; the Discovery hills, including the last and extending eastward, two hundred and fifty to one hundred and fifty; Shoot Flying hill, one-half mile north-west from Great pond in Barnstable, about two hundred; German's hill, in Yarmouth, one hundred and thirty-eight; Scargo hill, in Dennis, one hundred and sixty-six; railroad summit at Brewster station, one hundred and twenty-five, and Mill hill, in Orleans, about one hundred and fifty.

This moraine forms the entire chain of the Elizabeth islands, fifteen miles long with an average width of one mile. Their contour throughout is very irregular, with no well-marked trend of the elevations, which are roughly outlined hills and ridges of variable height, enclosing many crooked and bowl-shaped hollows which often hold small ponds. Their material is glacial drift with abundant angular boulders of all sizes up to twenty or thirty feet in diameter. In a few places this unmodified till was seen enclosing or passing into stratified gravel and sand. The surface exhibits all the characteristic features of the upper till,

being loose, yellowish in the color of its detritus, and with its boulders almost invariably angular except as they have been rounded by exposure to the weather. This deposit also appears to form the greater part of the cliffs upon the shores of these islands. At the north-east end of Naushon, however, in deepening an old well, from forty-five to sixty-seven feet, only the dark and compact lower till, or ground moraine, was found.

The trend of this chain of islands is about east-north-east, but on the peninsula of Cape Cod the same belt of hills, continuing with its width, contour and material unchanged, bends within a few miles to a course nearly due north. A railroad cutting thirty feet deep in these deposits, near Wood's Holl, and shallower sections on the Quisset hills, show two or three feet of yellowish till at top, succeeded below by light gray till, equally coarse but apparently more compact, with some of its fragments planed and striated. The latter was probably accumulated beneath the ice-margin, while the former was dropped by its meltings.

After holding its way northward ten or twelve miles, reaching to a point about a mile south of North Sandwich, the range turns at a right angle to a course a few degrees south of east. Some portions of it in this vicinity are strown with boulders; but mainly, as shown on the roads which cross these hills south-west and south from Sandwich village, at the highest portion of the entire series, they consist of stratified gravel and sand with boulders rare or entirely wanting. There is also a change to a more simple contour with fewer irregular hills and hollows.

From its angle the range extends about thirty-five miles to the east shore of the Cape. Through Sandwich and Barnstable it lies about a mile south of the railroad, consisting in the latter town of hills one hundred to two hundred feet high, apparently formed of modified drift, with frequent boulders embedded in it and scattered upon its surface. In Yarmouth the series is somewhat broken, and the railroad crosses it upon a sand plain a little west of German's hill. South of Dennis pond and for one and a half miles north-east from German's hill to Follin's pond, it is very well shown in exceedingly rocky low hills. Next it appears to suffer an offset of about two miles to the north, being represented by Scargo hill in Dennis, which is modified drift with only few boulders. Thence it runs a little north of east six miles to Brewster station, where it is again crossed by the railroad.

Through most of this distance it is very rocky, some of its blocks being twenty to thirty feet or more in diameter. Its further course is mostly modified drift with occasional boulders, passing east-north-east to Mill hill, Orleans village, and the south-east side of Town cove, beyond which it is concealed beneath the ocean.

The conclusion of Mr. Clarence King,[1] that Naushon island which he examined, forms part of a terminal moraine of the continental ice-sheet, seems to explain the accumulation of this remarkable series of hills. The border of the ice, after falling back from its farthest limit, stopped at this line or re-advanced to it, and afterwards remained nearly stationary through a long period, in which the materials that it contained were being continually brought forward and deposited. In many places these would be pushed into very irregular heaps and ridges by slight retreats and advances of the ice margin. At the same time we should also expect that thick beds of ground moraine would be gathered beneath the ice near its termination. The withdrawal of the ice-sheet would then leave these deposits as upper and lower till, one overlying the other in a long but broken and undulating range.

The angle of this range at North Sandwich shows that the portion of the ice-sheet on the west and that on the east pushed against each other here, the motion and slope of each being directed toward its line of frontal moraine. The medial moraine produced where their slope came together north from the angle of their terminal line, is presented in Rocky, Manomet and Pine hills, which form a gigantic ridge in the east part of Plymouth, four miles long from north to south, with a continuous height three hundred to four hundred feet above the sea. Abundant angular boulders of all sizes up to twenty feet in diameter strew its surface. At the north end of this ridge the sea has undermined its base, forming a steep slope sixty feet in height. A section here showed twenty feet of upper till, yellowish, with abundant large and small boulders, nearly all of them angular, underlain by lower till, dark bluish gray, with small glaciated stones, exposed for twenty feet vertically but concealed below. The bed of boulders which forms the shore at this point came mostly from the upper stratum, and their sharp corners and edges have since been worn away by the waves.

[1] Proceedings of Boston Society of Natural History, Vol. XIX, p. 62.

Besides the till, or boulder-drift, it has been stated that stratified gravel and sand, nearly or quite free from boulders, make up a large part of these series of morainic hills, including their highest portions on Long Island and Cape Cod. We thus see that the ice was aided in the accumulation of its terminal deposits by streams laden with vast quantities of modified drift. These streams appear to have been formed during the meltings of summer upon the surface of the ice-fields, especially at the period when they yielded and were driven back by a warmer climate.

To understand how such rivers could get their freight of gravel, sand and silt, we must consider what the ice-sheet was. The interior of Greenland is now covered by a similar field of ice, which rises steeply at its edge, but after a few miles changes to a gently inclined plateau, elevated above the highest peaks of the land on which it lies, and apparently of immeasurable extent. Dr. Hayes found the angle of ascent on this plain to decrease from six to two degrees in thirty miles, at which distance he reached an altitude of about five thousand feet. The ice of the glacial period had a similar, but probably less steep, ascent from its terminal front northward. The temperature of its area was changed so that the snows of autumn, winter and spring were not entirely removed in summer, but very slowly increased in depth, their lower portion being changed to solid ice. This continued through so long a period that the surface of this ice-sheet was lifted above the highest mountains of New England. At the White mountains, two hundred miles north from its border, it rose to a height at least 6300 feet above our present sea-level. Its greatest thickness was far to the north, from which region the vast pressure of its own weight caused it to flow slowly outward. Even its lower portion, which rested on the uneven surface of the land was thus pushed forward over all our hills and mountains, transporting boulders and marking its course on the ledges. Over British America, as far north as the surface geology has been explored, and to the most southern limit reached by the ice-sheet, which coincides nearly with the course of the Columbia, Missouri and Ohio rivers and the south coast of New England, the direction of its motion, as shown by the striæ, was generally southward, being nearly due south in British Columbia, south-west in the region of the great lakes, and south-east between Hudson river and the Gulf of St. Lawrence. The loose materials which covered the

land were ploughed up, and as the ice moved forward over the irregular surface, it became more or less filled with boulders, gravel and sand, at least to the height of the peaks and ridges which it crossed. Differences in the slope of the surface of ice above, like those which made an angle in the terminal moraine, due apparently to inequalities in the amount of snowfall and of melting upon adjacent regions, must also produce downward and upward currents by which these materials would be distributed throughout the lower part of the ice, probably to the height of several hundred feet, even while crossing a nearly level area.

By the melting of the ice-sheet at and near its terminal front, this detritus was exposed, through every summer, to the washing of many rills and small streams; but before its retreat under a change of climate, this melting was extended over a very wide area. The surface of the ice was then hollowed into basins of drainage and channelled by rivers, which became heavily freighted with the gravel, sand and clay that had been held in its mass. A large portion of this gravel and sand was heaped at the edge of the ice-sheet, where these glacial rivers descended to the lower open area beyond. When the ice behind them disappeared these deposits were left in the massive hills and ridges of stratified drift which form so prominent a part of these series of terminal moraines. [*To be Continued.*]

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THE GEOLOGICAL MUSEUM OF THE SCHOOL OF MINES, COLUMBIA COLLEGE.

BY ISRAEL C. RUSSELL.

AS it is impossible for every one to visit distant lands, or even at all seasons to go forth into the fields and among the mountains in quest of geological knowledge, we desire to call the attention of our readers to a collection in our country which in a great measure will supply these wants. We refer to the Geological Museum under the direction of Prof. J. S. Newberry, at the School of Mines, Columbia College, New York city. Here the visitor will find a most interesting display of the remains of the ancient inhabitants of the globe, gathered not only from the rocks of our own country, but also from the most distant lands, and each arranged in its proper place in the long series.

The geological museum occupies the entire third story of the

eastern wing of the School of Mines building, and consists of four collections, all of which, however, have an intimate connection with each other. The first and most interesting of these is the geological and palæontological collection, which will be the subject of our present sketch. This is supplemented (firstly) by a lithological collection consisting of three thousand specimens of rocks and the minerals which compose rocks; (secondly) by a collection in economic geology, containing nine thousand specimens of coal, ores, marbles, fertilizers, etc., illustrating the mineral wealth of our country, and containing also suites of ores and associated rocks from many of the most important mines in foreign lands; (thirdly) as an aid to the study of the fossil remains of animals and plants, which constitute the most attractive branch of geological knowledge, a zoölogical and botanical collection has been added, composed of well-selected specimens which in some peculiar manner serve to explain the fossil forms. This collection in some departments, as in that of fishes, contains many remarkable and interesting and valuable specimens.

The portion of the museum to which we wish to introduce the reader is the first we have mentioned, that of geology and palæontology. This collection occupies the wall and table cases on the eastern side of the hall; many large specimens, however, as the skeleton of the Irish elk, a cast of the Megatherium, etc., are arranged in various parts of the museum.

The cases, commencing at the northern end of the hall and extending throughout its entire length, present the geological records from the earliest dawn of life on our planet down to the last chapter in its history—the introduction of man.

These sibyl's pages, gathered from the ends of the earth, present an epitome of the world's ancient history written by the unprejudiced hand of nature. These fragments of stone with the curious forms of animals and plants engraved upon them, are to the geologist—the interpreter of the earth's history—what the hieroglyphics of Egypt or the picture-writings of Mexico are to the archæologist—the translator of human history.

Before we enter into an examination of the remains of animals and plants which once lived upon the earth, but are now extinct, we should clearly understand that fossils are the records which these ancient organisms have left of their existence. In some instances, as with the Irish elk and the moa of New Zealand,

we find the bones themselves but little altered from their original condition. At other times the organic matter of the specimen, a piece of wood, a bone, a shell it may be, have been replaced by silica so as not only to retain the general form, but even the most minute structure of the original substance. Such a replacement is called petrifaction. Wood is frequently thus petrified so as to preserve its microscopical structure as perfect as it was when the plant was yet in leaf. Again we may find but the impression of a fern or of a fish, made in soft mud or sand, which has been hardened into rock and has faithfully preserved the form of the frail body that perished ages ago. The plastic mud along the shores of bays and rivers is frequently trodden by animals or pitted by falling rain-drops; such a surface by becoming covered by a layer of sand or mud may retain for indefinite ages the inscriptions thus impressed upon it. In these and many other ways, the life-history of distant ages has been written on the rocks and preserved to our own day, with an accuracy and fidelity which cannot be too highly appreciated.

The great interest connected with the first appearance of life on the globe is indicated by the prolonged discussion that took place in reference to the organic nature of the eozoōn, which, as far as at present known, is truly the "dawn animal" of the world. Specimens of this interesting fossil are contained in the first case at the northern end of the geological hall. Now that we have made the first step in our journey through the geological ages as here arranged, we will pass slowly down the long row of cases, and in doing so, review hastily the life-history of the earth.

The Eozoōn belongs to the lowest sub-kingdom of animal life, the *Protozoa*, which also embraces our familiar sponges, the structureless amœba, etc. The case containing the Eozoōn shows us also the forms of life that followed this humble beginning. These are the fossils of the Silurian age, or the age of mollusks, as it is sometimes called in reference to the great abundance of the remains of "shell-fish," which far outnumber all the other fossils of this formation. The collection contains six thousand specimens of this ancient fauna, which were all embraced in the first four sub-kingdoms of animal life. The *Protozoa* are represented by the Eozoon, sponges, receptaculites, etc.:—the Radiates by corals, crinoids, and star-fishes. The Mollusks, as we have mentioned, were in great force, as the fossil shells testify. The

numerous trilobites, with the Eurypterus, Pterygotus, etc., show us that the Crustaceans were the highest form of life on our continent during the Silurian age. But while the Crustaceans were the highest in point of structure, yet they were far inferior in size and strength to the Cephalopods, the highest of the Mollusks, which lived in the same seas. These were represented by huge Orthoceratites. As we stand beside the cases containing these beautifully preserved remains, it is not difficult to restore them once more in fancy to the ancient waters in which they lived, and to picture to ourselves the appearance of the earth in that distant age. All the remains of animal life which these cases contain are those of marine forms. All the remains of plants, too, discovered in the rocks of this age have been classed with the Algæ (or sea-weeds). Judging from the fossil records, which, however, we feel are incomplete, we conclude that no plants grew upon the Silurian land areas.[1] There was then but the broad ocean and the wild desolate shores, uninhabited by beast, or bird, or plant—even more dreary and silent than are now the barrenest islands of the southern oceans. Along these primeval shores the waves rolled in and ground away the rocks as they do on the coast to-day, and retreating left the sands with a ripple-marked surface or covered with the trails of worms and crustaceans. Many of the shell-fish and trilobites lived along the shore, perhaps sheltered by clumps of sea-weed and clinging brachiopods, others inhabited deeper waters and contributed their remains to the formation of the limestone in which we now find them.

With this imperfect glimpse of our country in the Silurian times, we must pass on to the fauna and flora of the next succeeding, Devonian, age. Again naming the era from the ruling forms of life, we call this the age of fishes. Although in Europe the first fishes made their appearance in the preceding age, yet in our country we find their earliest remains in the Devonian rocks, throughout which time they continued to be the highest forms of life on the globe. What at once strikes the observer upon glancing over the splendid display of Devonian fossils here brought together, is the almost total absence of the forms with which we have already become familiar in the Silurian. Here begins a new chapter in the ancient archives. The few inches

[1] Since this was written a number of species of land plants have been described from the Silurian rocks of our country by Mr. Leo Lesquereux.

that separate the Silurian from the Devonian fossils represent in reality an immense lapse of time, during which the fauna of the world underwent great changes. We will not say that all the old forms of life were exterminated and new beings created to take their places, nor can we prove that during these unknown ages the laws of development were slowly changing the plastic organisms into new forms better adapted to meet the altered conditions under which they were forced to live. We can only say that the record is broken: to-morrow the missing chapters may be discovered and new light thrown upon the enigma, but to-day we must pass it by. But while most of the fossils of the Devonian differ in genera and species from those of the older fauna, yet they belong to the same families and orders, with the exception, of course, of the fishes, which are new to the life of the world. The corals, mollusks, and crustaceans are present in great numbers, and in a general way resemble their representatives in the Silurian, but on the whole they present greater diversity and indicate more advanced conditions. The presence of corals in the rocks of this age in what are now the Arctic regions indicates that there was little diversity of climate at the time these animals were alive.

The fossils which particularly attract the attention in these cases, and which will always be a center of interest to the student of the Devonian, are the remains of fishes, of which this collection contains a grand display that is unrivaled by any other museum in this country. Many of these fossils are unique, and in some instances are the only specimens of their kind known; many of them being the types figured by Prof. Newberry in the Geological Reports of Ohio. Among the first objects to attract the attention are the great sword-shaped spines which are the type-specimens of the genus *Machæracanthus*; these highly-polished spines, some of which are twenty inches in length, are samples of the weapons worn by the old Devonian sharks. These ancient fish-spines illustrate the economy that is shown in so many of nature's works, in gaining great strength with the use of the smallest possible amount of material. Here also are the type-specimens of the genera *Acanthaspis* and *Acantholepis*, which show a strange combination of plate and spine that is unknown in modern fishes. Another slab of limestone shows the head of an old Devonian fish that measures seven or eight inches in length. The head of this fish was completely encased with solid bony plates that

were strongly united by sutures and highly ornamented on the exposed surfaces. This fish, which has received the long name of *Macropetalichthys*, seems to have had many features in common with the structure of the living sturgeon. One of the strangest fishes that ever swam in the Devonian seas, and which surpasses in interest even the *Pterichthys* and *Coccosteus* of the old world, is the *Onychodus*. Among the most unique specimens in the museum is a slab of limestone from the Corniferous rocks of Ohio, containing a nearly perfect mandible of this fish, which is fourteen inches in length and set with sharp conical teeth. At the junction of the two rami of the lower jaw, there occurs a crest of seven large curved teeth which seem to have projected beyond the massive jaws, thus forming a terrible weapon, whose use seems to have been analogous to that of the sword in the living sword-fish. Far more wonderful than any of these, and one of the strangest monsters ever exhumed from the cemeteries of the primeval world, is the *Dinichthys*, described by Prof. Newberry from the Huron shales of Ohio. The nearly perfect bony casing of this "terrible fish," which is exhibited, shows it to have been upwards of twenty feet in length; and judging from its formidable armament, it was by far the most destructive creature yet known from the Devonian rocks. The jaws are massive plates of dense bone, each two feet in length, and provided with sharp-cutting and serrated edges. The anterior ends of the mandibles are upturned and united so as to form one immense tusk-like tooth, which shuts in between two equally massive premaxillaries on the upper jaw. The jaws of *Dinichthys* may be well represented by the arms of a man extended to their full length with the hands turned up and pressed together to represent the great tooth at the junction of the mandibles. One of the most curious and interesting features connected with this discovery is the striking analogy that exists between the structure of the *Dinichthys* and the mud-fish (*Lepidosiren*) now living in the rivers of Africa and South America. The number of these Devonian fishes is so great that we can but glance at a few of the more interesting ones that remain. Beside the dorsal shield of *Coccosteus* from the Old Red Sandstone of Scotland, is placed the only similar specimen known of *Coccosteus* from this country. Here too is the type-specimen of the genus *Heliodus*, one of the most ancient of the Dipnoi. Specimens of *Rhynchodus* show us that the modern Chimæra belongs to a very ancient family.

We cannot linger over these ancient relics, which are but waiting the pen of a Hugh Miller to make them familiar to every reader in our land, but must pass on to other features of the Devonian, which are well exhibited in these cases. Our readers will remember that the shores of the Silurian ocean were barren solitudes. Not so was it in the Devonian. We have here before us the remains of a strange and luxuriant flora that shaded the land. Ferns grew luxuriantly; above these flourished the strange *Lepidodendrons*, with which we shall become more familiar in the age that follows. We have here the first appearance of the most beautiful of land-plants, the tree-ferns, which at the present day form such an attractive feature in the scenery of the tropics and of the islands of the South Pacific.

The next series of cases contains the remains of the fauna and flora that flourished in the Carboniferous times—the age which witnessed the formation of the great coal-fields of America. Here the scene again changes. The mollusks and crustaceans, the huge ganoids and the strange flora, of the Devonian age, have disappeared never to return again. Another cycle in the world's history has been completed. The fossils which we have now to examine are, as before, the remains of shells, fishes, plants, etc., but all very different from those of the Devonian. Fishes appear again in great numbers, but not the huge Placoganoids that we saw before, but the elegantly-formed Lepidoganoids, covered with little plates of enameled bone. The most beautiful of these fossil fishes are from the cannel coal deposits of Linton, Ohio. The fossilization in these specimens is peculiar. Each little plate of mail and each delicately-penciled fin seem wrought in gold-leaf on a black ground. In reality, the substance which represents the fish is iron-pyrites, on a surface of impure coal. These little fishes have received the generic title of *Eurylepis*, in reference to the breadth of their scales, and such specific names as *corrugata*, *insculpta*, *lineata*, *ornatissima*, etc., suggested by their delicate ornamentation. Specimens of *Cœlacanthus*, which occur with the *Eurylepis*, are even more highly ornamented, and have their scales and head-plates so elegantly chased that the most skillful gem-engraver could scarcely imitate their delicate tracery. The great fin-spines which these cases contain, show that the sharks were strongly represented in the Carboniferous waters. Here too are the teeth of the most gigantic ray ever discovered (*Archæobatis*),

some of the flat crushing teeth of which were six inches in length, four inches wide, and an inch and a half thick.

Some of the slabs of stone from Linton, Ohio, upon being split open, showed the heads, limbs, scales, etc., of *Amphibians*, represented at the present time by the frogs and salamanders. It is at once apparent that this is the heading of a new chapter. In all the stony pages that we have glanced over, we have not seen characters like these. If we should follow out the records here begun, through all the following ages, we would find, indeed, that it is a chapter of wonders, containing the lives and struggles of the hugest and strangest monsters that have ever lived. We cannot pass on, however, without glancing at the flora of the Carboniferous, the relics of which these cases contain to overflowing. These forms, that are traced so delicately on the stones, were once living plants that millions of years ago bowed to the passing winds and drank in the sunshine as our most familiar trees and ferns do to-day. These fragments of trunks, branches, leaves and cones give us a faint glimpse into the dark moist forests that clothed our land in the coal period. Many of the fossil plants we at once recognize as ferns, so nearly do they approach in form these beautiful plants which we meet in all our rambles. Others, after considerable study, have been shown to be closely related to the little ground-pines or club mosses, which are also quite common in our woods. These ancient Lycopods, however, instead of being only a few inches in height, with cones an inch long, were gigantic trees sometimes upwards of seventy or eighty feet in length, with elegantly scarred trunks, and bearing large cones upon their gracefully pendant boughs. Another of our common plants, the Equisetum, also had giant representatives in that ancient flora. These, together with the Sigillarias, with their beautifully fluted columnar trunks, furnished the material from which our great stores of coal were formed. What at once appears as a remarkable fact upon looking over these fossils, is that they all belong to the lowest grade of vegetation, the cryptogamous or flowerless plants. Among all the hundreds of coal plants here assembled, we look in vain for so much as a single leaf of a broad-leaved plant like our maples and oaks. It was long supposed that there was a total lack of flowers in the Carboniferous forests, but a specimen in this collection shows a branch of some unknown plant with the remains of flowers clearly distinguishable.

As we pass on to the records of the next succeeding (Mesozoic) eras, the mediæval age of geology, we find no mention made of the luxuriant forests and the abundant animal life that passed before. Nearly all remembrance of these seems lost in antiquity. This age, in reference to the predominating forms of life, is called the reptilian age. The first indications that we have of these new rulers of the land and sea, are their foot-prints, left along the muddy shores. Some of these from New Jersey and the Connecticut valley are shown in the case of Triassic fossils. These wonderful impressions are so well known through the writings of Prof. Hitchcock and others, that we need do no more than mention them. The rocks in which these foot-prints were found have also furnished great numbers of fossil fishes. Among hundreds of specimens of these Triassic fishes here assembled, there is one called *Ptycholepis,* with highly ornamented head-plates and plicated scales, which is the only American specimen known of this genus, which occurs in the Lias of Europe; here too is the only specimen yet discovered of *Diplurus*; this was lately obtained from the Triassic rocks at Boonton, N. J. The rocks of this age have also yielded the oldest remains known of the Mammalia. This sub-kingdom makes its appearance in one of its humblest orders, the Marsupials, represented at the present day by the opossum and the kangaroo.

In the flora of the earlier portion of this age we find ferns, calamites, and conifers, with the addition of a new feature, the Cycads. As we pass on to the cases containing the fossil plants from the latest period of this age, the Cretaceous, we come suddenly to a splendid display of fossil leaves which have a wonderfully familiar appearance; they are the leaves of oaks, willows, maples, beeches, sycamores, etc., which the most casual observer would refer to the same genera that are living at the present day. There are differences which show that all these fossil leaves are specifically distinct from their modern representatives.

Among the most striking forms of animal life in the Mesozoic, were the Cephalopod shells, related to the living Nautilus. Of these, the ammonites which were foreshadowed by goniatites in the Devonian and Carboniferous, and began to assume their characteristic elegance of outline in the Triassic, in the Cretaceous attain a degree of variety and beauty that could with difficulty be excelled. It is interesting to observe that after these mollusks

had slowly attained this surpassing degree of elegance and ornamentation, the whole family became extinct. The collection contains many of these chambered shells from the Cretaceous of the Upper Missouri, which still retain their nacreous walls, that after the lapse of ages are as beautifully iridescent as any living shell. Here also are the bones of some of the great reptiles of the Cretaceous, the teeth of fishes, and a great variety of shells and plants from the same rocks. Many of these specimens are of great scientific value, as they are the type-specimens upon which many of the genera and species of Cretaceous fossils were founded.

The last case at the southern end of the geological hall contains the fossils of the Tertiary period, the last period but one before the age of man. A glance at the contents of this case shows us that all the grand divisions of animals and plants which are living at the present day, are represented. The shells of this period exhibit a very modern aspect, especially when compared with the older ones we have been studying; although many of them belong to living genera, yet nearly all the species are extinct. The tertiary plants, which are shown in great abundance, prove that the flora was not very different in its general character from that clothing the Middle States at the present day. The higher vertebrates at this time appeared in such numbers and variety that this age is known as the age of mammals.

While lingering over the cases of Silurian fossils, we attempted briefly to retrace the picture of that age, with its small and barren land areas and its great oceans tenanted by the lowest forms of animals and plants. Let us contrast with the silent barren aspect of our continent in those primeval days, its appearance in Tertiary times. North America had then attained nearly its present outline, although extensive regions along the Atlantic and Gulf borders were yet beneath the ocean, and great lakes occupied the western interior. A flora of temperate or sub-tropical growth clothed the area of the United States, and the climate of Virginia reached as far northward as Greenland. The splendid collection of Tertiary plants from the region of the Upper Missouri, the Yellowstone, and other portions of the West, shows that the banks of the Tertiary lakes, which then existed at these localities but have since been filled, were fringed with a varied and beautiful vegetation. We find among these fossil plants the leaves of the maple,

oak, hickory, conifers, etc., together with others that now grow far to the southward, as the palm, magnolia, cinnamon, and fig. Many of these fossil leaves are of double value, as they are the type-specimens from which Prof. Newberry has described and figured this wonderful flora, rich both in species and individuals. When we inquire what animals lived in these luxuriant forests, a vast menagerie of strange forms passes before us. We can do no more than call a hasty muster-roll of names. Our country was then inhabited by great numbers of animals more or less related to our modern horse, tapir, wolf, panther, stag, musk, rhinoceros, camel, llama, etc. Besides these there were a large number whose modern representatives are not so well known,—as the *Oreodon*, *Menodus*, *Uintatherium*, *Hyænodon*, and many others. This is but a meager list of the great number of Tertiary animals that have been discovered, but sufficient to show that a far richer and more wonderful assemblage of animals inhabited our land at that time than can now be found living on any continent; not even the jungles of India can produce such an array of gigantic pachyderms and carnivores as then lived in this country.

Again we are obliged to add, as with all the preceding ages, that both the luxuriant forests and these thousands of strange animals have become extinct, never again to appear on the earth. Dana remarks that "all the fishes, birds, reptiles and mammals of the Tertiary are extinct species."

As we are writing sober facts and not attempting to trace an Arabian tale, we should hesitate to speak of the times that follow the Tertiary, so strange and wonderful are they, did we not have in the collection before us the unquestionable facts engraved upon tables of stone. As the climate of the Middle States in former ages extended to Greenland, so, on the other hand, there came a time, after all the fair picture of Tertiary days was blotted out, when the present climate of Greenland, with vast snow-fields and continental glaciers, reached as far southward as New York and Cincinnati;—a time when glaciers many thousands of feet in thickness moved southward over our Northern States, grinding down the country and exterminating nearly every form of life that before had found there a congenial home. This collection contains a large number of specimens of the boulders, the boulder-clay, and the polished and scratched surfaces, that the glaciers left behind them.

After the snow and ice of this great geological winter had passed away, and a climate very similar to that which we now enjoy had covered the land with its present flora and fauna, we find the first clearly acceptable evidence of the presence of man. The geological records before us are brought down to our own time by many relics of the stone-age of Europe and America, besides a collection illustrating the arts of the Egyptians and Etruscans. Here, too, is a cast of the celebrated fossil-man of Guadaloupe, the original of which is in the British Museum.

One of the most interesting truths illustrated by the geological collections at the School of Mines, is the fact of the humble beginning of both plant and animal life on our globe, and their constant increase both in variety and specialization, as we follow their progress through the geological ages. Every one who is interested in the great question of our time—evolution—should make himself familiar with a collection of fossils arranged geologically, in order that he may see with his own eyes the facts written in the great stone book of the geologist, on which the man of science bases his theories and conclusions.

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RECENT LITERATURE.

BREHM'S ANIMAL LIFE, BIRDS.[1]—Lovers of birds, even if they are not those of the United States, will be interested in this excellent work of Dr. Brehm, of which the first two volumes lie before us. The first volume begins with an account of the skeleton, and anatomy of the soft parts, while their physiology is briefly discussed, also the motions of birds, their songs and powers of speech, sense-faculties, psychology, distribution, development, their everyday life, their courtships, pairing, nesting and breeding habits, early life and migrations. Dr. Brehm's classification is as follows: The parrots head the series and form the first order; they are succeeded by the trogons, etc. (*Levirostres*), the humming birds (*Strisores*), the fourth order of *Pici*; then come the birds of prey. The second volume completes the account of the *Accipitres*; these are succeeded by the Passerine birds, the second volume ending with the *Gyratores*, or pigeons, and the dodo. It will be seen from this enumeration that the classification adopted by the author, a distinguished German ornithologist, is somewhat unlike that of Lilljeborg, a Swedish naturalist, adopted by most American authors, as the Passeres are, at the present day, placed

[1] *Brehm's Thierleben.* Allegemeine Kunde des Thierreichs. Grosse Ausgabe. Zweite Abtheilung. Die Vogel. Von Dr. A. E. BREHM. Band 1, 2. Leipzig, 1878. 8vo. New York, B. Westermann & Co. 40 cents a part.

at the head of the class. It is also unfortunate that the "orders" of birds are perpetuated, even in a popular work, since it is doubtful whether they should rank higher than sub-orders.

The singing birds (*Passeres*) are treated with great fullness of detail, and as these form the larger proportion of our native birds, amateurs and naturalists will find this a most popular and useful part of the work. The index of each volume is voluminous, while the illustrations are abundant and beautiful, the two volumes containing 346 woodcuts, many of them of life size, and thirty-seven full-page engravings, mostly drawn by Mützel, Kretschmer and others. They are fully up to the standard of those in the earlier volumes of the series, to which we have called attention.

The birds will be completed in a third volume. Two additional volumes will be devoted to fishes, finishing the series of ten volumes announced by the publisher, and which will, without doubt, be issued during the coming year.

SMITH'S STALK-EYED CRUSTACEA OF THE ATLANTIC COAST.[1] —This paper is based on the collections of the U. S. Fish Commission, and is of great value. In it are enumerated seventy-nine species of decapod Crustacea, which are or have been found in the limits named. Many so-called species are here for the first time united, a feature which agrees perfectly with the reviewer's convictions. These seventy-nine species have been described under 126 specific names. In relation to the geographical distribution of *Carcinus mœnas* we would say that we have found it in the collection of Union College, from Northhampton county, Eastern shore, Atlantic side, Virginia. This is the farthest south that the species has been observed on this coast. A new species of *Geryon* (*G. quinquedens*) is described and figured, as is the only other known species (*G. tridens*). It differs from Kroyer's species in having the antero-lateral margin five toothed. *Cancer borealis* is figured for the first time. *Chionœcetes behringianus* Stm., is shown to be synonymous with *C. opilio* (O. Fabr. sp.). The name *Libinia canaliculata* Say, has to give precedence to *L. emarginata* Leach. *Parapagurus pilosimanus* (nov. gen. et sp.) is described. This genus is allied to *Eupagurus* and *Paguristis*, but has the gills composed of cylindrical papillæ instead of lamellæ as in most Paguroids. We have observed a similar structure in the genus *Carcinus*. A second species of the genus *Sabinea* (*S. sarsii*) is described and figured. *Hippolyte securifrons* Norman, is new to our coast. *Pandalus annulicornis* has to give way to the name *P. montagui*. In regard to *Palæmonetes vulgaris* we would say that besides the specimens from Salem Mill-pond (C. Cooke) we have seen specimens in the museum of the Peabody Academy at

[1] *The Stalk-eyed Crustaceans of the Atlantic Coast of North America, north of Cape Cod.* By S. I. SMITH. (Trans. of the Connecticut Academy of Arts and Sciences, Vol. V, pp. 27–136, pls. VIII–XII, May, 1879.)

Salem, from Lynn, Mass. (collector's name not given) and Massachusetts bay (Capt. W. H. A. Putnam). *Meterythrops*, a new genus of Schizopoda is characterized and figured. It has the cephalothoracic appendages of *Parerythrops* with the abdominal feet in the female rudimentary, and in the male as in *Erythrops*. Sar's *Chiromysis microps* is shown to be congeneric with *Heteromysis formosa* Smith. Following this list, which we have thus briefly noticed, is a valuable account of the geographical distribution of these species. We would, however, note that contrary to the statement on pp. 127 and 128, the genus *Platyonychus* is represented in Europe by two species, *P. nasutus* of the Mediterranean, and *P. latipes*, with a larger distribution. It is shown that contrary to the opinion of European zoölogists, the fauna of Greenland is as closely allied to that of North America as to that of Europe, " or in other words, it is only part of the great arctic, circumpolar fauna."—*J. S. Kingsley.*

Ingersoll's Nests and Eggs of American Birds.[1]—Our notice of this important accession to the literature of American ornithology has been too long delayed. It is a work for which there is room, and one which bids fair to take and fill acceptably a place of its own. No work has yet been provided for the special needs of American oölogists, the one attempted many years ago by Dr. Brewer having failed of accomplishment after the issue of the first fascicle. There are very many persons in this country, especially among the rising generation, who will be glad to have an egg-book "all to themselves"—one that will teach them the distinctive breeding habits of birds, enable them thus to find nests and eggs, and when found to make a collection of them. Such a work Mr. Ingersoll proposes to furnish, and the first installment of his undertaking gives promise that he will discharge his self-imposed obligation faithfully.

To judge from the portion already issued, this treatise will win its distinctive position and secure a name among numerous competitors in the field ornithological, by conforming to the implication of its title. Mr. Ingersoll does wisely, we take it, in restricting himself rigorously to his theme, even at the expense of a certain appearance of incompleteness which may strike some unfavorably; for it would be of no special use to undertake the systematic treatment of North America ornithology. Evidently believing that good style may be serviceable even in statement of fact, the author would combine literary excellence with scientific merit. Recognizing, furthermore, how much has already been done in his chosen field, he seems to prefer to quote a satisfactory description of nest or egg rather than to produce a duplicate, the concern being rather for the quality than the source of the informa-

[1] *Nests and Eggs of American Birds.* By Ernest Ingersoll. S. E. Cassino, Naturalists' Agency, Salem, Mass. Part I, pp. 24, pls. II. (*Pub. March*, 1879.)

tion he has to offer. These are all such desirable points that their faithful observance throughout the work cannot fail of good result.

The present Part treats of about a dozen species of *Turdidæ*. We doubt that it is a fair sample of what the whole work will be, as we presume the author will improve as he settles more closely to his task; yet the standard here attained is high, fully warranting what we have already said. The appearance of the work is attractive, and the mechanical execution good, with one exception: the references to the plates are insufficiently explicit, or rather not prominent enough. It is impossible to number or letter plates too plainly, or make the textual references too conspicuous. We venture to suggest to the author, that, at the risk of typographical difformity in succeeding parts, the full reference to the plate and figure be made a conspicuous part of each species-heading; and to the publisher we further recommend that the lettering of the plates be bolder. As Allen recently said, in substance, in the *Nuttall Bulletin*, the names of the species the eggs of which are figured, might be advantageously substituted for the legend now usurping a place at the bottom of the plates; and this running title be transferred to the right hand top corner.

There is one grave defect of the work that we cannot suffer to pass unrebuked. There is nothing to show whether Part I was published in March, 1879, as happens to be the case, or in some other month of some other year. In giving no date, both author and publisher, they and their book, run their chances of being mentally consigned by some irate bibliographer of the future to a less desirable place than a niche in the temple of posthumous fame. We are personally cognizant of various persons who have already, in fact, met with a fate so deplorable, on this very account.

It remains to speak of the execution of the plates, briefly, for the less said the better, unless it should stimulate the artist and publisher to renewed exertion to bring the drawing, shading and coloring of the figures nearer the standard of excellence required for the fit illustration of so admirable a treatise as the "Nests and Eggs of American Birds" aspires and promises to be.—*E. C.*

TEXAN ORNITHOLOGY.—After lying fallow for some years, the field of ornithology along our south-western frontier has been worked over with energy and success by several competent observers, whose labor has resulted in adding some *thirty* species to the recognized fauna of the United States, besides greatly enlarging the bounds of our knowledge of the life-histories of these and numerous other birds with which we were none too familiar. The name of Mr. H. W. Henshaw will instantly recur to one in this connection; if we remember rightly, not having the exact figures at pen-point, about half of these acquisitions

have been made through his exertions, and fully elaborated in the reports of the surveys to which he has been so long and so usefully attached, either by himself alone or in connection with Dr. H. C. Yarrow. His operations having been mainly in New Mexico, Arizona and California, it has remained for others to do the like good service in Texas, and especially in the fruitful valley of the Lower Rio Grande, where so many Mexican birds intrude upon our own territory. The three prominent workers in this field of late, are Mr. George B. Sennett, late of Erie, Pa., Dr. James C Merrill, U. S. Army, and Lieut. C. A. H. McCauley, 3d U. S. Artillery.

When, in 1841, the late J. P. Giraud published his sixteen new species of birds from "Texas," the decidedly sub-tropical cast of the fauna of some parts of Texas was not fully recognized, and much doubt was felt that all these birds really came from their accredited locality. They have, however, been mostly rediscovered over our present border, and the true character of the bird-fauna of the Lower Rio Grande has been very thoroughly exposed by the investigations of Sennett and Merrill. McCauley worked farther north and west, in a region which, though not well known ornithologically, was not to be expected to yield Mexican novelties. His paper,[1] however, gave precision if not great enlargement to our knowledge, and very acceptably supplements Dr. S. W. Woodhouse's observations, published in 1853, with fresh and more extended notes on the habits and distribution of various species.

Mr. Sennett spent two months in the early spring of 1877 on the southern border of Texas, from the mouth of the great river to about a hundred miles inland; working with an assiduity that merited the large measure of success achieved, Mr. Sennett made an extensive collection, backed by copious field notes, and published[2] his results the following year. Containing a great store of fresh observations well worked up, this paper attracted much attention and received so many favorable notices that further endorsement of its claims to regard are scarcely required here. It may be stated, however, that Mr. Sennett's collection of 1877 contained several species new to our fauna, one of them new to science (*Parula nigrilora*), and another furnishing the occasion for the establishment of a new genus (*Æchmoptila albifrons*).[3] Seeing what abundant harvest was still to be reaped in that quarter, Mr. Sennett revisited Texas the following year, and made

[1] Notes on the Ornithology of the Region about the Source of the Red River of Texas, etc. Bull. U. S. Geol. and Geog. Surv. Terr., Vol. III, No. 3, May 15, 1877, pp. 655–695.

[2] Notes on the Ornithology of the Lower Rio Grande of Texas, etc. Bull. U. S. Geol. and Geog. Surv. Terr., Vol. IV, No. 1, Feb. 5, 1878, pp. 1–56.

[3] *Leptoptila albifrons*, a Pigeon new to the United States Fauna. Bull. Nutt. Ornith. Club, Vol. II, No. 2, July, 1877, pp. 82, 83.

still more important discoveries. Some of his results of 1878 have already been published,[1] including the announcement of five species new to our fauna, and the full account of that season's operations is now in press. Having had the pleasure of seeing his MS., we are confident that the forthcoming paper will rival its predecessor in importance and interest of contents; nor is it too much to add that Mr. Sennett shares equally with Mr. Henshaw and Dr. Merrill in the credit to be given for the development of the ornithology of our south-western border.

Meanwhile, however, a member of the medical staff of the army, as we are happy to say, had been showing that zeal in the cause of science which does honor to our corps, by his protracted and diligent researches in the same field. We have before had advices from Dr. Merrill on different occasions,[2] and have lately been favored with the full results of his observations, under Mr. Ridgway's able editorship, in a paper[3] which it is more particularly our present purpose to notice. According to an editorial note, Dr. Merrill's additions to the United States fauna are twelve in number, including two also taken by Mr. Sennett and first published by us as such, namely, the Mexican *Myiarchus* and *Buteo albocaudatus*, as well as the *Podiceps dominicus*, which raised such a grave question in the mind of Dr. Brewer. Four of them, the two *Amaziliæ*, *Parra gymnostoma* and *Nyctidromus albicollis* represent three genera not before recognized as North American.

[1] Later Notes on Texan Birds.—I [-V]. *Science News*, Vol. I, No. 4, Dec. 15, 1878, pp. 57–59; No. 7, Feb. 1, 1879, pp. 106, 107; No. 8, Feb. 15, 1879, pp. 120, 121; No. 9, March 1, 1879, pp. 132–134. No. 10, March 15, 1879, pp. 151–153.

New Birds for the United States Fauna. *The Country*, July 13, 1878, p. 184, top of first column. (Buteo albicaudatus, Scops enano, Crotophaga sulcirostris, Pitangus derbyanus, Ornithion incanescens [by error for *O. imberbe*].)

[2] Notes on Texan Birds. Bull. Nutt. Ornith. Club, Vol. I, No. 4, Nov., 1876, pp. 88, 89. (*Molothrus æneus*, *Nyctidromus albicollis*, *Pyrrhophæna riefferi*, *Parra gymnostoma*, *Podiceps dominicus*.)

A Humming Bird New to the Fauna of the United States. Bull. Nutt. Ornith. Club, Vol. II, No. 1, Jan., 1877, p. 26. (*Amazilia cerviniventris*.)

Note on *Podiceps diminicus*. By Elliott Coues. Ibid.

Dr. T. M. Brewer takes exceptions to the substance of our note in this case, much as usual of late. The point he raises might perhaps be settled if either of us knew whether the channel of the Rio Grande runs nearer the right or the left bank at Fort Brown; or even if he could satisfy himself that the same grebe might swim across the channel.

Notes on *Molothrus æneus*. Tom. cit. No. 4, Oct., 1877, pp. 85–87.

Occurrence of the Western Nonpareil and Berlandier's Wren at Fort Brown, Texas. Ibid, pp. 109, 110.

Occurrence of *Myiarchus crinitus* var. *erythrocercus* Sclat., at Fort Brown, Texas. Op. cit., Vol. III, No. 2, April, 1878, pp. 99, 100.

A new North American Buteo (*albocaudatus*). *The Country*, July 13, 1878, p. 184, near bottom of column.

Two more Birds new to the Fauna of North America. Bull. Nutt. Ornith. Club, III, No. 3, July, 1878, p. 152. (*Vireo flavoviridis*, *Sturnella mexicana*.)

[3] Notes on the Ornithology of Southern Texas, being a list of birds observed in the vicinity of Fort Brown, Texas, from February, 1876, to June, 1878. Proc. U. S. Nat. Mus., Vol. I, Oct., 1878, pp. 118–173, 3 pls.

Besides including these interesting novelties, Dr. Merrill's paper, like Mr. Sennett's, gives copious field notes of habits gathered in the course of the author's long experience with the subjects of his communication. The list of species reaches the large number of 252; and yet we understand that none are included which did not come under Dr. Merrill's personal observation. This is certainly a good showing, though doubtless no one knows better than the author himself that still further additions remain to be made to it. The large collections upon which the list is based were sent to the Smithsonian from time to time, and there carefully examined by Mr. Ridgway, upon whose authority the identifications rest. The same ornithologist has added much to the value of the paper by his critical commentary, and his insertion of extensive synonymatic lists and descriptions of the species new to our fauna or otherwise specially noteworthy. The evident care with which he has made his determinations causes us to regret the more our difference of opinion respecting the identification of the Mexican *Myiarchus*, which we had before satisfied ourselves to be *erythrocercus* of Sclater and Salvin, and a geographical race of *crinitus*. It seems to us useless to attempt to do anything with so doubtful a bird as *cooperi* of Kaup; and we must adhere to our previous decision. The hummers before announced as *Amazilia cerviniventris* and *Pyrrhophæna riefferi* are renamed respectively *A. yucatanensis* and *A. fuscicaudata*. The paper is further enriched by various oölogical notes contributed by Dr. Brewer, who appears to have examined the very large number of eggs collected by Dr. Merrill, and who has also given that slight sketch of the geographical distribution of *Podiceps dominicus*, to which we have already alluded. It is accompanied also by three of Mr. Ridgway's plates, so excellent in details of external form, representing *Parra gymnostoma*, *Æchmoptila albifrons*, *Nyctidromus albicollis* and several species of *Caprimulgus*. Under such circumstances, both of authorship and editorship, it is not surprising that the paper forms one of the most notable contributions ever made to Texan ornithology, being, as such, quite worthy to rank with those of Sennett and Henshaw.[1]—*E. C.*

RECENT BOOKS AND PAMPHLETS.—On the apical and oral Systems of the Echinodermata. By P. Herbert Carpenter. Part II. (Reprinted from the Quarterly Journal of Microscopical Science, XIX, new series.) 8vo, pp. 31.

The Geology of the Diamantiferous Region of the Province of Paraná, Brazil. By Orville A. Derby. (English version.) (Read before the American Philosophical Society, May 16, 1879.) 8vo, pp. 8.

[1] See also Mr. Brewster's review of the same paper, in the Nuttall Bulletin for January, 1879, pp. 50–52. A private note from Dr. Merrill informs us of a few typographical oversights which may be here noted. Page 128 *Embernagra rufivirgata*; p. 138 *Myiarchus erythrocercus*; p. 134 *Sturnella mexicana* should all be asterisked, and p. 133 *Sturnella magna* should not be thus marked. Page 131 insert initials "R. R." after "habitat;" p. 156 ditto after "measurements." Page 164 under *Herodias egretta*, the reference to "the preceding species" means *Plegadis guarauna* not *Ardea herodias*.

A List of the Fishes of Essex County, including those of Massachusets Bay, according to the latest results of the work of the U. S. Fish Commission. By G. Brown Goode and Tarleton N. Bean. (From the Bulletin of the Essex Institute, Vol. XI.) 8vo, pp. 38.

Notice of Recent Scientific Publications in Brazil. O. A. Derby on the Geology of the Lower Amazonas. By Richard Rathbun. (From the American Journal of Science and Arts, Vol. XVII, June, 1879.) 8vo, pp. 5.

Geological History of Jersey County. By Hon. William McAdams. Otterville, Ill. 4to, pp. 24.

Ist das Eozoon ein Versteinerter Werzefflüsster oder ein Mineral gemenge? Von Dr. Karl Möbius. (Separatabdruck aus der Zeitschrift. "Die Natur," Jahrgang, 1879, Ur. 7, 8, 10, Nalle.) 8vo, pp. 29, 21 illustrations.

Notes on Pacific coast Crustacea. By W. N. Lockington. (From the Bulletin of the Essex Institute, Vol. X, Nos. 10, 11, 12, 1878.) 8vo, pp. 7.

Description of a new species of Chirocephalus. By John A. Ryder. (From Proceedings of the Academy of Natural Sciences of Philadelphia.) 8vo, pp. 2.

Boletin del Ministerio de Fomento de la República Mexicana. (Daily Weather Report.) Folio. April 17th to May 8th, 1879. Mexico. From the Director of the Observatory.

Index Medicus: A monthly classified record of the current medical literature of the world. Compiled under the supervision of Dr. J. S. Billings, surgeon U.S.A., and Dr. Robert Fletcher, M.R.C.S., Eng. Vol. I, No. 4, April, 1879. 8vo, pp. 169–220. New York, F. Leypoldt. From the editors.

Catalogue of the Flowering Plants, Ferns and Fungi growing in the vicinity of Cincinnati. By Jos. F. James. 8vo, pp. 27. (Abst. from the Jour. Cin. Soc. Nat. History, April, 1879.) From the author.

A Revised List of Birds of Central New York. Based on the observations of Frank R. Rathbun, H. Gilbert Fowler, Frank A. Wright, Samuel F. Rathbun. Collated and prepared by Frank R. Rathbun. 8vo, pp. 47. Auburn, N. Y. (April 17th), 1879. From the Compiler.

Beskrivelse af Hovedskallen af et Kæmpedovendyr, Grypotherium Darwinii, fra La Plata-Landenes plejstocene Dannelser. Af. J. Reinhardt. Avec un résumé en Francaise. (Abst. Videnskab. Selsk. Skr., 5 Raekke. Naturvidenskabelig og mathematisk Afd. XII, 4.) 4to, pp. 353–380, Taf. I and II. Kjöbenhavn, 1879. From the author.

Characeæ Americanæ. Illustrated and described by Timothy F. Allen, A.M., M.D., etc. Part II.—Chara crinita Wallr. var. Americana. 4to, text and one plate. Published by the author, No. 10 E. 36th street, New York. From the author.

Aberrant dentition of Felis tigris. By R. Lydekker, B.A. (From Jour. Asiat. Soc. Bengal, Vol. XLVII, pt. II, 1878. Read Feb. 6, 1878.) 8vo, pp. 3, pl. I. From the author.

Further notices of Siwalik Mammalia. By R. Lydekker, B.A. Geol. Survey of India. (From Records Indian Geol. Surv., No. 1, 1879) 8vo, pp. 33–52, with a plate. From the author.

Geology of Kashmûr (3d notice). By R. Lydekker, B. A. (Records Geol. Surv. of India, No. 1, 1879.) 8vo, pp. 15–32, and map. From the author.

Palæontologia Indica. (Memoirs of the Geological Survey of India.) Ser. IV. Indian Pretertiary Vertebrata. Vol. I, part 3.—Fossil Reptilia and Batrachia. By R. Lydekker, B.A., of the Survey. 4to, pp. 36, and six plates. Calcutta, 1879. From the author.

Anales del Museo Nacional de Mexico. Tomo I, Entrega 6a. 4to, pp. 237–278, 3 plates. Mexico, 1879. From the director of the Museum.

The Quarterly Journal of the Geological Society, Vol. XXXV, No. 138, May 1, 1879. 8vo, pp. 350, pls. 4. London, Longmans, Green, Reader and Dyer. From the Society.

Bulletin of the American Metrological Society. Officers, Committees, Constitution, By Laws. New York, 1879. From the society.

GENERAL NOTES.

BOTANY.

The Root of Oxalis violacea.—The violet wood-sorrel is an abundant plant in this locality, growing commonly on gravelly hillsides. On comparing it with descriptions it seems to agree in all essential points noted by authors; but there is one striking peculiarity of the root which appears to have been overlooked—at least I have not been able to find the slightest reference to it in any work that I have examined. This is the usual occurrence of a white, carrot-shaped root beneath the ordinary scaly bulb. When there is a bunch of plants a cluster of the tap-roots may be formed. They are only lightly attached to the under surface of the bulbs, so that when broken off the scar left is almost imperceptible. They consist for the most part of a watery fluid, which can be easily squeezed out, leaving but little solid substance. A thin, clear skin, together with the large quantity of water present, renders them somewhat translucent. The size varies, but from two to three inches appears to be the usual length. I have found them an inch or two long the first week in May, which shows that they are early developed. A not unpleasant sweet taste recommends them to children as suitable for eating; no injurious effects are noticeable.

During the past two years I have dug up many plants of this species in order to determine the presence or absence of such bottom roots. In most cases they were present, but in many they were not, though for what reason was not evident. Often of two plants side by side, one would possess the root fully developed and the other show no sign of it. Is this a feature of *Oxalis violacea* throughout its range? The observations of collectors in other parts of the country can decide the question.—*T. S. Roberts, Minneapolis, Minn.*

Botanical News.—The first volumes of the sixth edition of Dr. Asa Gray's Botanical Text Book, to be issued in four volumes, has just appeared under the title of "Structural Botany; or Organography on the Basis of Morphology," to which is added the principles of taxonomy and phytography, and a glossary of botanical terms. Three other volumes are contemplated as parts of this great work, one on physiological botany, by Prof. Goodale; one on cryptogamous botany, by Prof. Farlow, and one on the normal orders of phænogamous plants, by Prof. Gray.——The collection of plants made by Prejevalsky in his second journey to Central Asia, together with that of Potanin, is being worked up by the eminent botanist, Maximovitch and Regel, and the results will be published in a fine work on the flora of Mongolia and Kan-su. ——Mr. Lesquereux, the authority on the fossil plants of North America has just issued an "Atlas to the Coal Flora of Pennsyl-

vania, and of the Carboniferous Formation throughout the United States. It will be invaluable to all those who wish to identify coal plants, as 260 species are figured.——The *Botanical Gazette* contains a note on the influence of the scion on the stock, by T. Meehan, with a number of other notices.——Trimen's *Journal of Botany* prints a note on the morphology of the Characeæ, by S. H. Vines.

ZOÖLOGY.[1]

HABITS OF THE RED-HEADED WOODPECKER.—During the past three or four years much has been written in regard to the changes which are taking place in the habits of the red-headed woodpecker—"a versatile bird," to quote the apt characterization of Dr. Elliott Coues. This bird is quite common here, though I am of the opinion that it is not seen in as large numbers as it was when the country was first settled, some twenty-two years ago. I have often seen them about my barn-yard industriously picking up corn which had been shelled for the swine. Generally the bird alights and secures a single grain, and then flies off to the nearest tree-top to peck it into pieces and devour it at his leisure, returning for others at frequent intervals. I have often watched them while they were making a score of these little journeys. In 1877 this region was overrun with grasshoppers, upon which the red-headed woodpeckers feasted royally while they lasted. I saw the birds out on the prairie, a mile or two from the timber, so intent upon catching the 'hoppers that they scarcely noticed one in passing. Sometimes they would catch a 'hopper on the wing, dodging around in a very lively manner to secure the insect, and again they would hunt for their prey on the ground. The insect secured, the bird would alight on a fence-post and devour it. I have occasionally seen them, attended by their progeny, in the open fields, where the old birds were engaged in catching insects for the clamorous younglings, which had not yet learned to provide for themselves. It would seem that, at the time the young birds require so much food, the old ones would need some readier means of supply than would be afforded by pecking for grubs in decayed timber, or searching for insects on the outside of trees—whether the "creepers" had intruded upon their domain or not. So far as I have been able to observe, the red-headed woodpecker is really a very "versatile bird," evincing a readiness of resource and an easy adaptation to his environment that are truly wonderful.—*Chas. Aldrich, Webster city, Iowa.*

FISH NOTES FROM THE PACIFIC COAST.—Several fine carp were caught recently in Sonoma creek, one of which weighed nearly eight pounds. They are said to bite like a trout and to make a good fight. Young catfish which were placed in Clear lake,

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

Lake county, last fall, and which at that time measured from one to three inches in length, are found to have grown rapidly; some have been caught within a few weeks that measured ten inches. Sturgeon fishing or spearing is being pursued extensively, as reported, in the Mokelumne river, at Athearn's ford. It is a quite frequent occurrence to capture specimens weighing from fifty to one hundred pounds.

The young trout with which the streams of Santa Cruz county have been stocked are natives, coming from the McCloud river. This species is regarded as the most vigorous, and frequently attains the weight of five pounds. It is said to have a growth of ten inches in one year. It is reported that the Commissioners in charge of the Yo Semite valley have decided to plant the McCloud river trout in the streams of the Yo Semite reservation. The experiments with the brook trout of the Atlantic States in the streams of the coast range, have not been satisfactory; this is owing, quitely likely, to two causes: first, too high a mean temperature in the waters of said streams; and second, through the impurities they contain, which must be especially obnoxious to so dainty a fish during the fall months when the streams are low, muddy and warm, and the water flavored more or less by the bituminous shales through or over which they frequently flow, and out of which ooze numerous small springs, often covered with an oily slime or scum. Experiments with eastern trout are much more likely to meet with success in the loftier regions of the Sierra Nevada, in the clear cold waters of a granitic formation, nearer the line of almost perpetual snow.

Santa Cruz fishermen sometimes catch a few mackerel and shad in the neighboring waters of the bay. The former are a native, the latter an introduced fish, but yet scarce. For some reason the mackerel do not strike in toward the shore to any considerable extent. In consequence of this, the few that are sent to the San Francisco market are sold at fancy prices.

Salmon commenced running in Puget Sound about the 25th of March.—*Robt. E. C. Stearns.*

NOTES ON THE APPLE-WORM.—Mr. J. Savage, of Lawrence, Kan., in a recent number of Colman's *Rural World* remarks upon the freedom of Michigan apples from the work of the apple-worm (*Carpocapsa pomonella*). This same freedom was generally noticed in 1878, not only in Michigan but in many parts of New York, and it doubtless obtained elsewhere. It will be well for us to endeavor to arrive at the reasons. To my mind the following, first stated by me in the New York *Tribune*, may very properly be urged: 1st. The very general failure of the apple crop in 1877, as exemplified in the reports for that year, which we find both in the Proceedings of the Michigan Pomological Society and in those of the American Pomological Society. This failure

was in many localities so nearly total that scarcely any apples were grown, and it follows, as a consequence, that very few codling moths were produced to perpetuate the species the following year. A second reason, so far as Michigan is concerned, may be found in the fact that in no State in the Union have more intelligent and persevering efforts been made to prevent its ravages. Through the columns of the agricultural and horticultural journals as well as in the pages of their pomological transactions, the simple methods of fighting this pest that have been reported and recommended in the Missouri reports have been persistently kept before the people, while Prof. Beal, of the Agricultural College, has, perhaps, done more good than any one else by showing that it cost him no more than four cents per tree to keep the bands around the trunks, changing them every nine days in the warm months, from the first appearance of the worms until the end of August, in an orchard of two hundred and fifty trees. I agree with him when he asserts that "if a man will not take the trouble to keep his fruit from the worms, he deserves to eat wormy apples."

Missouri apple growers should take courage from these facts. Since my connection with the Department of Agriculture there have been sent to me four different kinds of patent bandages to be used as traps for this apple-worm, but I can find no advantage in any of them over the simple paper bandages first recommended by me in 1872, and since very generally employed.—*Prof. C. V. Riley before the Mo. State Hort. Soc.*, 1879.

Does the Snowy Owl Breed in the United States?—The snowy owl (*Nyctea nivea*) is a common winter visitant, near Chicago. It frequents the haunts of rabbits and various members of the grouse tribe. On the borders of Lake Ontario, in the great wooded marshes, these birds find thousands of rabbits roaming in night time in the frozen tracts. They are caught here in large numbers, and the author recalls the capture of fifteen of these during the winter of 1875, near Mexico, New York. The manner in which they are captured is of no little interest. During the day they take to the open lots adjoining the marshes, but in the night ravage the woods. They are seldom known to leave the small area selected for their depredations, unless driven away. In the day area they have but three or four places on which they alight, and when they are disturbed are sure to fly to one or other of these places, often moving in a circuit for hours. A high stake being placed in the center of the open lot, and a small steel-trap placed thereon they will speedily take to the stake in preference to other resorts, and are consequently caught. No bait is placed in the trap, the bird being caught by making simple use of the peculiarity of their habits. Their white plumage gives them the appearance of the snow beneath them, so that they may

dart swiftly on their prey, almost unperceived. There is a matter regarding the snowy owl in which ignorance of their habits or scientific assumption must predominate. The assumption is that they are strictly boreal, or Arctic, in their breeding habits. Many farmers, however, along Lake Ontario assert they are seen there during the entire year, and there is consequently a belief among them that they breed there. In the "North Woods" of New York the author once saw a young snowy owl—not nearly full fledged—shot by a hunter in early spring. The hunter persisted that the bird was one of several young seen by him in proximity to each other. I am not yet prepared to believe that they breed in that latitude, but record the current opinions for the use of any one who may investigate the matter fully.—*W. H. Ballou.*

Double-headed Snakes.—In the Am. Naturalist (Oct., 1878, p. 694), the essay on the Natural History of Guiana (1769) should have been credited to Edward Bancroft whose name stands at the end of the dedication. The monstrous snake of Lake Champlain with two heads side by side seems to be of an unknown species, judging from the doubtful checker-board spots, although it is compared with "the rattle-snake." Here "amphisbœna" is a misnomer, as the name implies the ability to go in both directions (forward and backward), a power possessed by these lacertians, both ends having nearly the same shape.—*S. S. Haldeman.*

Amia calva.—We have received a letter from Jacob Stauffer, of Lancaster, Pa., in which he states that a specimen of *Amia calva* has recently been taken in the Susquehanna river, below Safe Harbor, and is now preserved in the Linnæan Society of Lancaster. This is the first definite account of the existence of this species in the Susquehanna, though as pointed out by Mr. Stauffer, DeKay had suspected it. Mr. Stauffer calls attention to the pouch enclosed between the sub-lingual bone and the throat of this fish, which has been little or not at all noticed by writers.

Habits of Ants.—In the sixth part of Sir John Lubbock's Observations on the habits of Ants, Bees and Wasps, the author shows that the hairs of plants keep insects from climbing up the stalks, as he believes, to prevent them from obtaining access to the flowers, and from robbing them of their honey. He also confirms Denny and Lespes' statement that workers ants are capable of laying eggs, and Forel and Dewitz's discovery that the eggs produce males, stating that he has bred in his nests "a large number of males;" thus, as in bees, the fertile workers can produce males only. That ants may live three or four years, and that in some nests 100,000 individuals may be by no means an unusual number, is also stated. Many facts regarding the recognition of friends are stated, indicating that "ants of the same nest do not recognize one

another by any password. On the other hand, if ants are removed from a nest in the pupa state, tended by strangers and then restored, some at least of their relatives are certainly puzzled, and in many cases doubt their claim to consanguinity. I say some, because while strangers, under the circumstances, would have been immediately attacked, these ants were in every case amicably received by the majority of the colony, and it was sometimes several hours before they came across one who did not recognize them." Lubbock believes that ants produce sounds, and alludes to a letter in *Nature* for December, from Mr. T. S. Tait, who writing from Baroda, says that by means of the microphone "we have been able to hear the roar [sic] of a black ant when attacked by its companion." Lubbock adds that "Prof. Bell most kindly set up for me an extremely sensitive microphone; it was attached to the under side of one of my nests, and though we could distinctly hear the ants walking about, we could not distinguish any other sound. It is, however, far from improbable that ants may produce sounds entirely beyond our range of hearing; indeed it is not impossible that insects may possess senses, or rather sensations, of which we can no more form an idea than we should have been able to conceive red or green if the human race had been blind. The human ear is sensitive to vibrations reaching to 38,000 in a second. The sensation of red is produced when 470 millions of millions of vibrations enter the eye in a similar time; but between these two numbers vibrations produce on us only the sensation of heat; we have no special organs of sense adapted to them. But there is no reason in the nature of things why this should be the case with other animals; and the problematical organs possessed by many of the lower forms favor the suggestion. If any apparatus could be devised by which the number of vibrations produced by any given cause could be lowered so as to be brought within the range of our ears, it is probable that the result would be most interesting."

He also relates an anecdote of the kind treatment, by its fellows, of an ant born without antennæ, adding, "It would have been difficult for any one who witnessed this scene to have denied to this ant the possession of human feelings." On the other hand when an ant is fighting with one of another species, her friends rarely come to her assistance. "They seem generally (unless a regular battle is taking place) to take no interest in the matter, and do not even stop to look on."

Rev. Mr. McCook, of Philadelphia, author of a recent work on the agricultural ant of Texas, states that the mandibles of ants are worn off and become blunted by the labor which they perform. His observations have been confirmed by Mr. E. P. Austin from the examination of the mandibles of nearly a hundred specimens of a ground beetle (*Pasimachus*). Mr. McCook early in July went to Colorado and New Mexico for the purpose of

studying the habits of the mound ant, *Pogonomyrmex occidentalis*, a common and characteristic ant of the Western plains.

A POISONOUS CENTIPEDE.—Last winter I discovered a living *Cermatia forceps* in wrapping paper in my house in Providence, R. I. It is possible that it came in a bundle from Princeton, N. J., and was not a native Rhode Islander. The Cermatia is the most highly developed of all Myriopods; has long sprawling legs, and is greenish-brown in color. It has not before been known to exist north of Philadelphia, and has been found there to be useful in destroying insects and spiders.—*A. S. Packard, Jr.*

ANTHROPOLOGY.[1]

MASTODON, MAMMOTH AND MAN.—The Rev. J. P. Maclean is the author of a small work published in Cincinnati, and entitled "Mastodon, Mammoth and Man." The interest in the public mind concerning the contemporaneity of man with the mastodon and mammoth, and the inaccessibility of reliable information on the subject, induced the author to compile this work. The subject of the great antiquity of these animals is not treated here, having been discussed more fully in the author's work entitled "A Manual of the Antiquity of Man." Part first of the volume now before us relates to the mastodon; part second to the mammoth, and part third to man. In the last chapter are brought together all the instances in which human bones or implements are alleged to have been found in conjunction with remains of the mastodon or the mammoth.

ARCHÆOLOGY AT ST. LOUIS AND PHILADELPHIA.—In the St. Louis loan exhibition the department of archæology was well represented from the collections of Dr. George Engelmann, Messrs. F. M. Perrine, M. S. Mepham, John H. Henderson, J. T. Snyder, F. F. Hilder, C. Croswell, A. J. Conant, Dr. Patrick, J. C. Zimmer and the collection of the St. Louis Academy of Sciences. Those who had the opportunity of enjoying the hospitality of these gentlemen at St. Louis, last summer, will remember the great beauty and value of some of these private collections. It makes one shudder to think how much precious material may be sported away at the mercy of a single friction match. Cannot some plan be devised by which a gentleman of taste and means may indulge in the luxury of a private collection in a fire-proof building, so arranged that the public may enjoy the sight of it without trenching on private hospitality?

On the heels of the foregoing announcement comes a pamphlet from our friend, Mr. E. A. Barber, number five of the Official Bulletin of the International Exhibition, Fairmount Park, Philadelphia, giving a full description of the department of archæology and ethnology, under his charge. "It is proposed also to estab-

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

lish a library of anthropological works which shall be free to all students in this department of science. At an early day classes will be formed which will be instructed in the various branches of the subject by means of a course of lectures, to be delivered by competent teachers and illustrated by means of the collections at hand."

CHUNGKEE STONES AND QUOITS seem to occur on the Susquehanna, in South-eastern Pennsylvania, the former with a shallow concavity on each side, deepening toward the center; the latter roughly lenticular, margin chipped to an edge; in a specimen before me (three and a-half inches in diameter) one side has a *fovea* for the thumb. Dr. Abbott's figure 210 may represent a quoit.—*S. S. Haldeman, Chickies, Pa.*

IRON AXES like figure 31 (AMERICAN NATURALIST, Dec., 1878, p. 785) are regarded as French. They occur in Pennsylvania on the Susquehanna, and are without steel. One before me has on each side the three impressed circlets thus $_*{}^*{}_*$, their interior shaped like a rude star, and not as in figure 31, which may be erroneous. See *American Antiquarian*, Jan., 1879, p. 170–2.—*S. S. H.*

ANTHROPOLOGICAL NEWS.—In the *Magazine of American History* for April, Dr. Charles Rau gives a letter from Mr. Worsaae, director of the Museum of Northern Antiquities, at Copenhagen, upon the transfer of the Dighton rock to the Society of Northern Antiquaries by Mr. Niels Amzen, and its re-transfer to the Boston committee upon a monument to commemorate the landing of the Northmen in North America.

Dr. Frank L. James, of Osceola, Arkansas, writes to the Smithsonian Institution describing vases with the orifice on the side of the neck, and bearing upon the bottom unmistakable evidence of having been moulded upon a gourd which was subsequently burned out.

Prof. Cleveland Abbe draws attention to an article in the *New England Historical and Genealogical Register*, Jan., 1879, by the Rev. Edmund F. Slafter, on pre-historic copper implements. The communication is in the form of an open letter to the Historical Society of Wisconsin. Mr. Slafter seeks, at first, to show from the cultivation of the savages in other directions that it does not seem to be an act of credulity to believe that the Indians of the early settlers were capable of manufacturing these copper implements by shaping them under the hammer or by casting them in moulds.

The second part of the article consists of testimony drawn from the journals of early European explorers or colonists showing that implements of copper were in use among, or were made by the Indians then inhabiting the country. Jacques Cartier, in

1535, on his second voyage, was informed by his two Indians who were with him that red copper came from Saguenay, meaning the Lake Superior region. He says, "The savages that we had with us told us that here was the beginning of Saguenay, and that the country was inhabited, and that from thence came the red copper which they called *caignetdaze*." Other references to this same *caignetdaze* are given from Cartier, and an extract from Champlain on copper implements. Prof. Abbe asks whether this word *caignetdaze* may have any connection with the origin of the word *Canada*. We have been under the impression that the Iroquois *Kanata* gave rise to the word Canada; but perhaps some of the readers of the NATURALIST can shed some light upon the subject.

Numbers 2, 3 and 4 of *Correspondenz-Blatt* contain a few papers of general interest. In number 2 we have a communication by Dr. von Christ before the Anthropological Society of Munich, upon Schliemann's excavations at Mycenæ, and a prospectus of the forthcoming anthropological exhibition at Moscow. In number 3, Prof. H. Fischer, of Freiburg, gives some further information upon the diffusion of hatchets of nephrite, jadeite and chloromelanite, especially in Europe. Dr. Korbin, of Berlin, contributes to number 4 a paper on new anthropological measuring apparatus and methods. In the same number Mr. Ingvald Undset reviews the anthropological literature of the North.

Mittheilungen der Anthropologischen Gesellschaft in Wien, numbers 10–12 of 1878, and 1–3 of 1879, also furnish original papers of general interest. It will be impossible to give more than the titles of the articles: Prähistorische Eisenschmeltz und Schmiedestätten in Mähren, by Dr. H. Wankel, Vol. VIII, 289; Ueber die Kosmogonie und Anthropogenie des germanischen Mythus, by Dr. M. Much, id., 324; Ueber die angeblich trepanirten Cranien des Beinhauses zu Sedlec in Böhmen, by Dr. Heinrich Wankel, id., 352; Archäologische Beiträge aus dem Osten Europas, by A. F. Teplouchoff, id., 360; Ueber die Wahl der kraniometrischen Ebenen, by Prof. Moriz Benedikt, Vol. IX, 1; Offener Brief an Herrn Prof. Benedikt von Paul Broca, id., 16; Die Ursitze der Gothen, by Dr. Fligier, id., 15; Künstliche Höhlen in Niederösterreich, by Dr. M. Much, id., 18; Germanische Befestigungen des oberen Waagthales in Ungarn, von Julius Neudeck, id., 29.

Archiv für Anthropologie, Vol. XI, part 3, Jan., 1879. Die communale "Zeitehe" und ihre Ueberreste, von M Kulischer; Das Urnenfeld von Maria-Rast, von Graf Gundaker Wurmbrand, pp. 231-280, with tables, IX–XIII; Ueber gewisse Ueberbleibsel embryonaler Formen in der Steissbeingegend beim ungebornen, neugebornen, und erwachsenen Menschen, von A. Ecker, 281–284.

Mittheilungen aus der russischen Literatur über Anthropologie und Archäologie, von Dr. Ludwig Stieda. Thirty titles exam-

ined, pp. 287–353 (best thing in the number, and first rate). Ueber einige neuere Arbeiten über das Gehirn, Prof. Dr. Pansch, in Kiel, 354–365; A review of Poesche's "Die Arier," A. Ecker; Ethnographisches aus der neueren Reiseliteratur, von F. Ralzel; A review of the transactions of learned societies and associations; The Fourth Russian Archæological Congress at Kasan; The British Association; International Congress; American Association. In this number we have the second of the series of catalogues of anthropological museums of Germany in the list of the Anthroplogical Collection of the University of Göttingen, founded by Blumenbach, by Dr. J. W. Spengel; and Catalogue of the Anthropological Collection of the University of Freiburg, by Alexander Ecker. Everything is nicely done in these lands.

M. Emile Cartailhac, the editor of *Matériaux pour l'Histoire de l'Homme*, sends us a pamphlet of 103 pages, entitled "L'Age de Pierre dans Les Souvenirs et Superstitions populaires, par M. Emile Cartailhac, avec 68 gravures et 2 planches dans le texte, Paris. C. Reinwald, 1878. The author has been engaged upon this study for some time past and has contributed several papers bearing thereupon to the *Matériaux*. We give the contents of the seven chapters:

I. La pierre de foudre, le coin du tonnerre.
II. Des haches de pierre transformées en amulettes.
III. Pointes de fleches en silex montées en argent et en or.
IV. Les bijoux et les charmes sous forme de pointes de flèches et de hachettes.
V. Le rôle des silex taillés dans les cérémonies religieuses en Orient et en Occident.
VI. De la transition de l'âge de pierre a l'âge de bronze.
VII. L'âge de pierre et les auteurs classiques de l'antiquité.

The following papers have come to notice since our last issue: The Practice of Medicine and Surgery by the Aboriginal races of the South-west, by Dr. W. J. Hoffman, Philadelphia Reporter, Feb. 22d, 3 pp.——The Ancient Cities of Cibola, Rev. S. Jackson, Rocky Mountain News, Jan.——The Failures and Fallacies of Prehistoric Archæology, Rev. J. A. Waddell, Southern Presbyterian Review, Oct.

GEOLOGY AND PALÆONTOLOGY.

A DECADE OF DOGS.—The Truckee beds of the White river formation in Oregon have yielded a larger number of species of *Canidæ* than any other American horizon, while representatives of other families of *Carnivora* are much less common. Ten species of dogs have been determined by Prof. Cope, which are referred to five genera, viz: *Enhydrocyon* Cope; *E. stenocephalus* and *E. basilatus; Temnocyon* Cope; *T. altigenis* and *T. coryphæus; Icticyon* Lund.; *I. crassivultus; Canis* L.; *C. geismarianus; C. lippincottianus; C. cuspigerus; C. gregarius; Amphicyon* Lart.; *A.* (?) *vetus.*

THE CLASSIFICATION OF ROCKS.—Mr. M. E. Wadsworth publishes in the Bulletin of the Museum of Comparative Zoölogy of Cambridge[1] an abstract of a thesis on the classification of rocks, from which we extract the following: "No natural distinction can be drawn between rocks of the Tertiary and Pre-Tertiary ages, since the glass and fluidal inclusions, crystalline texture, and the various other characters fail, exactly where they are most needed, to divide the rocks into older and younger, as is done by the majority of lithologists.

"The writer believes that rocks should be studied, by beginning with their most compact or glassy state, and by then tracing them through to the most crystalline form, following every alteration, whether it be chemical or mechanical. Every rock that can be traced in this way forms a distinct species, whatever may be its state,—whether amorphous, glassy, crystalline, fragmental, tufaceous, or otherwise,—and whatever may be its age. The modifications, if of sufficient importance, form varieties simply, which should be included under the specific name. A natural classification of rocks must be empirical, and must be based on the rock as a whole, while a natural mineralogical classification is an impossibility, as it is based on part of the characters only.

"If we except the veinstones and the majority of those rocks that are composed of one mineral, the species of rock forming the crust of the globe are very few. Believing that this earth is a cooling globe, all manifestations of internal heat giving rise to rocks (the only thing with which we are at present concerned) are here termed volcanic, and all such products are styled volcanic rocks. The testimony of the rocks is that all sedimentary forms came primarily from volcanic ones, volcanic energy having been more active than now in the past ages of the globe. This derivation is consonant with that which we see taking place at the present time, and agrees with the law of dissipation of energy; while the reverse view, at present popular,—that eruptive rocks were derived from sedimentary ones,—is contrary to the positive testimony of the rocks themselves, to the facts that are observed in nature, and to physical laws.

"Taking the consolidation of any rock as its initial point, the minerals and rock fragments contained therein fall naturally into three classes: 1. Minerals and fragments of prior origin; 2. The products of that consolidation; 3. The products of alteration and infiltration.

"These three classes are most marked in the volcanic rocks, as is natural; the first two predominating in the younger and least altered, the latter in the older and more altered ones, while the first and third classes predominate in sedimentary rocks. These alterations apparently take place through the agency of the ordi-

[1] Vol. V., No. 13, 1879.

nary percolating waters, which are not necessarily hot. The minerals and fragments of the first class, I find, fall into two divisions in the volcanic rocks: 1. Those that are characteristic of the rock species, and which were probably derived from the refusion of this species, that had crystallized at the depth at which it was prior to the eruption; 2. Those that are accidental, probably caught in the passage upward or during the outflow. Similar divisions are found, to a greater or less extent, in the sedimentary rocks, according as they were derived from one or more rocks, and also according to the preponderance of different rock fragments and minerals in them. Details of these occurrences will be given in the final publication.

"Believing that new names should not be employed, except in cases of absolute necessity for filling gaps in the classification, the effort has been made to retain all the old names that are necessary, in their most general use, and to reject all needless ones, that can be so dealt with.

"Starting with the basic rocks, I shall pass from the glassy states to the most crystalline, from the least altered to the most altered, and from the massive to the clastic, keeping on a similar range of chemical composition, and tracing the various gradations step by step. I shall also, in like manner, trace the gradations from the basic to the more acidic rocks, showing the gradual changes that exist in that direction as well. Since, owing to the necessities of the case, both in the use of these observations in a thesis and in giving a post-graduate course in lithology in this Museum, my work was made public before it was entirely completed, it has been deemed necessary to publish this abstract in advance. Several matters of detail yet remain to be worked out, which may modify some of the general views. All that is liable to be so modified must, therefore, be withheld for the present."

GEOLOGICAL AND PALÆONTOLOGICAL NEWS.—M. Mariano Barcena continues his researches on the geology and palæontology of Mexico in the Anales del Museo Nacional de Mexico.—Dr. Lydekker publishes descriptions of extinct reptiles of India in the memoirs of the Geological Survey of India. He describes *Sauropterygia*, *Crocodilia*, *Theromorpha* and *Dinosauria;* including *Dicynodon*, *Titanosaurus indicus*, *Plesiosaurus*, etc. Dr. Lydekker in another paper describes an extinct *Quadrumane* from the Sewaliks of Punjaub, of rather larger size than the orang outang, which he names *Palæopithecus sivalensis*.——Mr. C. D. Walcott of Albany, N. Y., continues his researches on the structure of the *Trilobita*, and gives us an account of the metamorphoses of *Triarthrus beckii* of the Trenton limestone. He also discusses the Utica slate and its fossils.——The Rev. W. H. Barris publishes in the proceedings of the Davenport Academy of Sciences an account of the local geology of Davenport, Iowa, and describes some new Corniferous fossils.

GEOGRAPHY AND TRAVELS.[1]

THE SLAVE TRADE IN CENTRAL AFRICA.—While the transportation of slaves from the coast to Zanzibar has been almost entirely stopped by the exertions of the British navy, slaves in large numbers are still brought to the coast mostly from the tribes living to the east of Lake Nyassa. Huge caravans are reported passing north along the coast, and probably these slaves are embarked from points far to the north in the Somali country. Others are smuggled into dhows by twos and threes at the coast towns, and so escape detection. The presence of Europeans even singly and unarmed in the interior has done much to discourage the kidnapping of the natives. A missionary in East Africa, writing to the London *Times*, quotes a chief as saying: "We don't want to sell slaves if we can get our wants supplied by other means. You have come here with cloth, and beads, and brass wire, things which we formerly bought with slaves, but now we can sell our grain, our rice, our beans, our eggs, our fowls for them, and we are well satisfied. As to gunpowder, you won't bring that and sell it to us, but we are safe now that you live here, people won't come to sell us into slavery; we are, like you, living in peace, and so we no longer want gunpowder."

The trade is also being stealthily carried on in the Red sea. An interesting letter to the *Times*, from Alexandria, gives an account of Col. Gordon's successful efforts to destroy this traffic in the Soudan. His rule extends from the first cataract of the Nile to the equatorial lakes, from the western frontier of Darfur to Cape Gardafui and the towns of Berbera and Zeyla on the Indian ocean.

Having succeeded in the first two years of his government in establishing order throughout his dominions, he next turned his attention to breaking up the trade in slaves, prevailing chiefly between tenth and fifth degrees of north latitude, and especially in the region described by Schweinfurth as forming the water-shed of the Bahr Gazel—a vast alluvial land formerly rich in population, corn and cattle, but now turned into "barren wildernesses." In 1871 Dr. Schweinfurth estimated that 2000 traders were annually obtaining 15,000 slaves from one set of tribes alone. In the last half of 1878, Col. Gordon arrested forty-two caravans and liberated the slaves. Finally he despatched Capt. Gessi with 3000 men against Suleyman, the principal slave dealer, who had broken out into open rebellion.

In an attack made by Suleyman, with 11,000 men, on Capt. Gessi's entrenched position on the 27th of December last, the rebels were totally defeated, leaving 1087 dead on the field, and on the following day 5000 deserters came over to Gessi's camp. "The enemy retired but Gessi followed them up and killed ten chiefs and over 2000 of his men, and is still in pursuit." The

[1] Edited by ELLIS H. YARNALL, Philadelphia.

capture of all the positions which at present serve as so many slave trade centers is considered now certain. The root of all the nefarious traffic will thus be destroyed, and the destruction of these merchants means the end of the trade.

Owing to the many natural impediments, Col. Gordon is convinced that the commercial highway of Europe to the rich equatorial districts of Africa does not lie along the Nile but by way of the Indian ocean.

MICROSCOPY.[1]

PURITY OF LAKE WATER.—In a Report on Microscopical Examinations of the water from Lake Michigan, as delivered from the city hydrants in Chicago, by Mr. B. W. Thomas, in the Third Annual Report of the Board of Public Works of that city, it is argued that the water for supplying the hydrants is taken from too near the shore, although pumped from cribs which are two miles out in the lake. After describing the method of obtaining organisms by filtering the water through a piece of cotton cloth tied in the form of a bag over the end of a faucet, and enumerating the harmless vegetable and animal forms that constitute nearly all of the filtrate obtained, the paper concludes as follows:

"But occasionally we find what is not quite so acceptable, for instance a *Tardigrada* (*Macrobiotus hufelandi*), a *Paramecium*, an *Anguillula fluviatilis*, a *Hydrachna*, a family of lively *Vorticellæ*, etc., that have evidently been carried out to the lake crib by the lake or river currents from the breakwater or shore, where, at certain seasons, they are found in great numbers, especially near the river or sewer outlets. Storms scatter these organisms in the waters of the lake for some considerable distance from the shore, and when once taken into the tunnels and mains they continue to multiply, and a few of them can be found in the water supply at almost all seasons of the year.

"Careful observation by different microscopists does not leave a reasonable doubt that nearly all of the impurities, properly so called, found in the water as drawn from the hydrants comes directly or indirectly from the sewage and river water that is discharged into the lake. So long ago as December, 1871, Prof. H. H. Babcock, in an article in *The Lens*, "on the effect of the reversal of the current of the Chicago river on the hydrant water," said that the microscopic examinations by himself and others interested in the same study "are sufficient to determine the fact that the reversal of the course of the Chicago river has decidedly increased the purity of the hydrant water by removing a large part of the organisms it had previously contained, and I have no doubt that the sanitary condition of the city—so marked at the time—was promoted by this change in the character of the water supply.

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

"Evidence in corroboration of statements like this is so abundant and easily obtained that it cannot be successfully refuted, and the only conclusion that I can arrive at is, that the purity of the hydrant water can only be maintained by preventing the discharge of all impurities into the lake, or by extending the tunnels a sufficient distance from the shore to be beyond their influence."

MICROMETRIC RULING.—Several observers now claim to have resolved the bands of lines 120,000 to the inch, by both Rogers and Fasoldt. Prof. Rogers' recent work has been devoted to the methods and instruments for obtaining aliquot parts of the standard yard and metre with great precision, rather than to the production of extremely close rulings. Mr. Fasoldt is now ruling twelve-band plates, with bands claiming from 12,500 to 150,000 lines to the inch.

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SCIENTIFIC NEWS.

— Congress, at the recent session, transferred the cotton worm investigation from the Department of Agriculture to the Department of the Interior, adding it to the work of the U. S. Entomological Commission, Prof. C. V. Riley, the chairman of the Commission, having resigned his position as Entomologist to the Agricultural Department, owing to the inability of the present Commissioner to appreciate scientific energy and methods, and to give due credit for them, in a department where they are needed just at present more than in any other. Prof. Riley, who has the investigation of the cotton worm in special charge, is now in Texas, with the agent of the Commission, Mr. Schwartz, and has already determined that the cotton worm hybernates in the moth state in the Cotton States; that the worms in Texas appear as early as the middle of May of nearly full size, nearly six weeks before they had ever been seen by the planter; experiments will also be made as to the best means of destroying the worm, on a large scale. Prof. A. S. Packard, Jr., is spending the summer in Colorado, Wyoming, Utah and Eastern Idaho, investigating the present status in the permanent breeding places of the Rocky Mountain locust, and Prof. Cyrus Thomas is to make a trip to Dakota for the same purpose. A number of agents are also at work in the West. The Commission also designs, incidentally to this investigation, working up the Chinch bug, Hessian fly and Canker worms, and has sent out circulars asking for local information as to the habits and statistics of losses. Entomologists are desired to coöperate in the work this season.

— Mr. King, director of the U. S. National Geological Survey, has secured the passage of a bill through Congress authorizing the extension of the operations of the survey over the several States of the Union. It is said that he proposes doing some

work in Tennessee the present year. This plan of Director King appears to us to be of doubtful propriety, and in fact only defensible on the supposition that Congress will treble its usual appropriation for the survey. Moreover, the people and legislatures of the several States should by no means be relieved of the responsibility of conducting their own geological surveys at their own expense. Mr. King also announces that the work of the survey will be restricted, at present, to mining and petrographic geology. This is in the line of contraction already anticipated by this Journal.

— We have received the announcement and description of the zoölogical laboratory of the Faculty of Sciences of the Catholic University of Lyons extracted from *The Contemporain* of March. It includes laboratories of anatomy, physiology, microscopy, drawing; also museum, aquarium, lecture room, etc. The appliances appear to be excellent.

— Prof. Harrison Allen has been elected to the chair of physiology in the University of Pennsylvania, and has resigned the professorship of zoölogy of the summer course. To this position Dr. A. J. Parker has been elected.

— Prof. H. C. Wood, of the University of Pennsylvania, is now engaged in physiological studies in Vienna, and Prof. Frances Emily White, of the Women's Medical College, of Philadelphia, is in London on a similar errand.

— Prof. W. M. Fontaine has been elected to the chair of natural history and botany in the University of Virginia.

— The *Penn Monthly* publishes in its July number an interesting article, by Edward Howland, on the language of animals.

— We learn that O. A. Derby is meeting with good success in Brazil, being in charge of the extensive geological collections made by the late Prof. C. F. Hartt. Mr. Derby is supported by the government, so that there are hopes that all the results of the work of the late Geological Commission will yet be made available to science.

— The Report of the Fruit Growers' Association of the Province of Ontario, for 1878, has just been received. It contains the Annual Report of the Entomological Society of the Province of Ontario, and papers relating to injurious insects, of considerable local interest.

— A general work on the Natural History of the Batrachians, by Dr. Friedr. Knauer, of Vienna, is announced. It will be in octavo, with 120 illustrations, 4 maps and 2 plates.

— H. Holt & Co., New York, have in press a Zoölogy for Colleges and High Schools, by A. S. Packard, Jr., to be published in September.

— The Massachusetts Board of Health have undertaken to make an investigation into the laws of the hereditary transmission of disease, and have issued a circular with a blank, which has been prepared for the collection of statistics, upon which can be based an investigation of the laws governing the inheritance of pathological conditions, abnormal characteristics of all kinds, and any family characteristics or peculiarities sufficiently marked to have been made the subject of observation. Those who may be interested in helping in the matter should apply to Prof. Alpheus Hyatt, Boston Society of Natural History, Boston, Mass., for the circular and blank, and return them when answered to the same address.

— The Summer School of the Johns Hopkins University will be located, the present summer, near the mouth of Chesapeake bay. Prof. Baird, of the Fish Commission, has given it the use of a steamer for dredging purposes, and the students will board on barges anchored in the bay. We have received, from time to time, Directions for Laboratory Work of the Teachers' Class in Elementary Zoölogy at the University. They are prepared by Prof. W. K. Brooks, on the general plan of Huxley and Martin's Biology, and seem to serve the purpose of giving the student a thorough, well-grounded knowledge of structural zoölogy, and we doubt if any other college would show more care and thoroughness in teaching. A few copies are for sale at the University.

— The great work of G. W. Tryon, Jr., on the Mollusca, has reached the third part of the *Cephalopoda.*

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New York Academy of Sciences, May 19.—Papers were read by Dr. R. P. Stevens on the corrugation of peat-marsh by pressure, and by S. W. Ford on the composition of the primordial fauna.

May 26.—Prof. J. S. Newberry made a communication on the former Cretaceous and Tertiary margin of the continent east of New York. Prof. D. S. Martin noticed the occurrence of Devonian beds at Monroe, Orange county New York.

Middlesex Scientific Field Club, Malden, Mass., June 4.—Frank S. Collins read a paper on the best methods of gathering and preserving sea weeds. L. L. Dame mentioned the occurrence of *Clematis* (Atragene) *verticillaris* in Medford. This plant has not before been recorded from Middlesex county. Miss Martha Silvester made some remarks on the genus Viola. A paper on the importance of visiting the large museums was presented by

M. A. Hardaker. She advocated the use of these museums, as the members would there learn by illustration the system used in Zoölogy, etc. H. L. Moody presented a list of eighteen species and one variety of Solidago found in Malden and vicinity, and made some remarks on doubtful species. Mr. Moody also mentioned that he had bred *Capnochroa fuliginosa* from the larva. The larva does not differ from the usual Cistelidous type. He had attempted to breed *Capnia pygmara* and a species of *Gordius* from eggs. The young Capnia were destroyed by other larvæ when of an age to be readily seen by the unaided eye. The Gordius larvæ are still alive.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS—June. The forests of Central Nevada, with some remarks on those of the adjacent regions, by C. S. Sargent. Notice of recent additions to the marine fauna of North America, No. 5, by A. E. Verrill. Polydactyle horses, recent and extinct, by O. C. Marsh.

THE JOURNAL OF CONCHOLOGY—May. Notes on the habits and distribution of certain West Indian Pulmonifera, by J. S. Gibbons.

ANNALES DES SCIENCES NATURELLES, VIII, NOS. 2, 3.—1878. Organization and development of some endoparasitic marine Trematodes, by M. Villot. Migrations and metamorphoses of the Tæniæ of moles (*Sorex*), by M. Villot. Dredgings off Marseilles, by M. Marion.

SIEBOLD UND KÖLLIKER'S ZEITSCHRIFT FÜR WISSENSCHAFTLICHE ZOOLOGIE.—May 26. Studies on the development of Sponges, by E. Metschnikoff. On the means by which mammals adhere and move upwards by atmospheric pressure on more or less perpendicular surfaces, by O. Monike. Contribution to a knowledge of the reproductive organs of free-living Copepoda, by A. Gruber, Researches on the finer structure of the digestive canal of *Emys europæa*, by J. Machate.

PSYCHE.—May, June. The anatomy of *Amblychila cylindriformis*, by C. F. Gissler.

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ERRATA.—Page 141, in *third* line of second paragraph, before the word "during" and after the word "well," in the *ninth* line. insert "quotation marks."
Page 142, *sixth* line from bottom of page, read "through being more," instead of "though more."
Page 147, *fourth* line from bottom of page, omit the word "specific."
Page 154, second paragraph, *last* word in *last* line, read "west" instead of "east."
Page 411, first paragraph *second* line, the word "south" should follow after "neighborhood."
Page 415, second paragraph *fourth* line, insert the word "an" before the word "increased."
Page 416, first paragraph *fifth* line from bottom, for "twist" read "twists."
Page 418, under the figure, for "Darley" read "Barley."
Page 419, second paragraph *fifth* line from bottom, after the word "spikelet" in the parenthesis, add "and fifteen to thirty spikelets in a single head."

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BRAZILIAN CORALS AND CORAL REEFS.

BY RICHARD RATHBUN.

OUR first accurate information regarding the character and extent of the Brazilian coral reefs, as well as of the sandstone reefs, dates from the earlier explorations of the late Prof. Hartt in Brazil. Prior to the publication of his general work, referred to in the June number of this journal, there existed only a few imperfect notices of corals and coral banks on the Brazilian coast. Spix and Von Martius, during their South American travels in the early part of this century, discovered patches of living and dead corals at several localities along the sea coast of Bahia, but they did not stop to fully investigate them or extend their observations, and the corals they collected were erroneously referred to old Lamarckian species.

Darwin, who touched at the Abrolhos islands, saw corals growing upon the shore, but overlooked the vast and curious reefs that occupy so much of the surrounding region. On the authority of others, however, he states that around these islands "the bottom of the sea is entirely coated by irregular masses of corals, which, although often of large size, do not reach the surface and form proper reefs." In this he was partly right, but very largely wrong, as we shall see farther on. Darwin also refers to coral reefs at Maceio and Pernambuco, and Prof. Dana mentions a reef near the latter place. Other observers had increased the number of localities where coral reefs occur, so that when Prof. Hartt began his studies of these structures, we were already acquainted, in a general way, with a line of scattered, and often widely separated, coral reefs and banks extending from the Abrolhos islands northward to Maranhão. Our information respecting them was,

however, very meagre, and usually unreliable. Only a very few species of Brazilian corals were known, and these were mostly Gorgonians from the bays of Bahia and Rio de Janeiro.

The sandstone reef and coral reef regions of Brazil are nearly coëxtensive, but while the stone reefs are always confined to the immediate neighborhood of the shore, coral reefs frequently lie some distance out, at times forty or fifty miles. It was while investigating the stone reef at Porto Seguro, in 1866, that Hartt's attention was first attracted to the coral reefs, one of which stretches across the mouth of the bay of Porto Seguro, in front of the sandstone structure. This reef was carefully studied, and growing upon it were discovered all the commoner Brazilian corals. A year later Prof. Hartt visited the Abrolhos islands, for the purpose of examining the many reefs that cluster about that little group of Continental islets. The trip was a very successful one, resulting in the discovery of new and interesting phenomena in connection with the formation of coral reefs. Many corals were obtained, including all the species previously found at Porto Seguro, and these constituted the first large collection of Brazilian corals to be properly studied and described. The work of classifying this material was entrusted to Prof. Verrill, of Yale College, who decided that nearly all the forms were new to science.

Prof. Hartt's studies on the Brazilian coast have proved that Madreporian corals grow abundantly on or near the shore, from Maranhão southward to Cape Frio; south of which only a few Astrangians have been collected. Coral reefs are, however, more restricted in their range, as they do not pass to the southward of the Abrolhos region. Just to the east of the Abrolhos islands, between these islands and the mainland, and thence northward to near the city of Bahia, coral reefs are very numerous, often fringing the shores, but more commonly growing in large and irregular patches in the deeper water. From Bahia to Maranhão coral reefs are much less abundant, being confined to certain localities near the shore. The Roccas, between Fernando de Noronha and the coast, are, however, entirely of coral. The Brazilian coral fauna is very poor in species, but, as far as it goes, closely resembles that of the West Indies, many of its species being representatives ones. A large number of the commoner West Indian genera, such as Madrepora, Mæandrina, Diploria, etc., are wanting to Brazil.

Having thus briefly defined our present knowledge of Brazilian corals and coral reefs, let us proceed to study them more in detail, as they appear to one traveling through the regions in which they are contained.

Rocky shores, although usually of a tame character, are not uncommon in the coral region of Brazil, and they afford a proper footing for the growth of corals, both as scattered masses and in the form of reefs. The Bay of Bahia has quite a rich coral fauna, and presenting a varied shore enables us to study well the several littoral and shallow water species. As we enter the bay through its broad mouth, high cliffs of gneiss stand up before us on the right, but they soon give way to a low, and often nearly level shore of Cretaceous shales, sandstones and conglomerates, which, interspersed with beaches of sand, border almost the entire bay. Long stretches of rock lie under the influence of the tides, being entirely covered during flood, and exposed at low water. In addition to these, countless ledges exist everywhere off the shore, and being always submerged are better suited for coral life.

In the many tide pools of the rocky surfaces, and just below the level of low tide, live in abundance two of the most common of the Brazilian corals, *Siderastræa stellata* and *Favia gravida.* These two species are almost always associated together, and they range throughout the entire coral region above defined. The former is, however, the more abundant, and attains the larger size; it is also the more hardy species, and at low tide may be exposed to a burning sun for an hour or more without sustaining injury. The size and shape of these coral masses, as well as the general structure of their cells, often vary greatly, according to the kind of rock on which they grow.

If the shore be formed of shales, presenting a level surface but affording only an insecure attachment, the corallum will spread outwards rather than upwards, giving rise to a thin flattened mass which may be over a foot and a half across and less than an inch thick. A smooth sandstone surface gives a firmer foundation, and permits, as it were, a thicker growth, although the tendency is still toward lateral spreading. Shores of gneiss and conglomerate are, however, generally rough and jagged, pierced with irregular holes and beset with multitudes of rounded or angular projections. On such a surface the growth of flat and level coralla is impossible; they tend to rise in hemispherical or globular

masses, conforming more or less in size and shape to the projections from which they spring. This law of variation seems to hold good for the entire coast. A small species of Porites occurs at times, associated with the two species above named.

A little deeper down, where they can seldom, if ever, be uncovered by even the lowest tides, come in other and more showy corals. Mussas grow profusely at many localities, seeming to prefer the abrupt outer edges of the submerged rocks. They belong to two species, one with separated cells not now living in the Bay of Bahia, the other having the cells closely joined nearly to their summits. Occasionally we find small heads of Orbicella and Acanthastræa in similar situations, but these more commonly inhabit deeper water. The same may also be said of Millepora, the hydroid coral, of which there are two common and one rare species on the Brazilian coast; in very shallow water it is stunted in growth and usually bears only short branches. Living on the under sides of stones, in company with encrusting bryozoans, is a very small Astrangian, consisting of many widely separated cells united by thin creeping stolons.

An Agaricia, very rare in the Bay of Bahia but more common elsewhere, generally grows attached to some other coral, as, for instance, to the dead base of Mussa. On the coast of Pernambuco there is also a small Stylaster attaching itself in the same way. *Pectinia braziliensis* is seldom found adhering to a rocky surface, but is very abundant at times in sheltered situations, partly buried in the mud. There remains only a single other Madreporian coral to mention here; it is the *Porites solida*, which seems to live nearly everywhere excepting in the Bay of Bahia.

This closes the list, with one or two exceptions of rare species, of the shallow water Madreporian corals of Brazil. The most of the species enumerated are very widely distributed, ranging along the entire coast north of Cape Frio. But they are not confined to the shore, for the majority also occur on the outer reefs, which are, so far as we know, entirely built up of a few of these same species. From depths ranging from twenty-seven to forty fathoms were procured several small corals; but these forms can, at the most, play only a very insignificant part in reef-building.

Let us return, however, to our studies in the bay. Five or six species of Gorgonians are abundant nearly everywhere, growing commonly from small stones and dead corals imbedded in the

sandy and muddy bottoms, as from the rocky surfaces which afford them a more secure foundation. Two or three additional forms have been found along the coast; but the soft nature of these corals does not permit of their entering into the structure of a reef, excepting as their minute spicules may be added to the calcareous sand or mud, a very important element in the formation of coral reefs.

We pass now from the corals proper to other organisms, that give rise to quite as durable a substance of the same chemical composition. These are among animals the Serpulæ and Barnacles, and among plants the Nullipores. They grow abundantly on the shore, forming encrusting layers or thickened masses; but we have treated very fully of these forms on page 352 of this journal, in connection with the sandstone reefs. The thin encrusting nullipores, with nearly smooth or slightly mammillate surface, which cover so much of the Pernambuco reef, inhabit also many of the rocky shores, but are more abundant over several of the coral reefs that have reached too high a level for the growth of true corals. There is another common nullipore, composed of many intermingling and closely placed branches, which project outwards in all directions as numerous digitations. This form grows to an immense size at times, and is associated with the corals in reef-building. A coarsely jointed coralline forms large and dense clusters on the coast of Pernambuco, and its detached segments sometimes form quite a thick deposit, especially on the surfaces of reefs.

The limestone-producing fauna and flora we have thus hastily reviewed, may not differ in their essential features from those of all the other coral regions in the world, but it has seemed best to treat of them as fully as we have, in order to show more clearly how few are the species of Brazilian corals, particularly those that can aid materially in the building up of reefs. Up to this time but thirteen species of Madreporian corals, representing ten genera, have been found on or about the Brazilian reefs, and of these only three or four ever attain to any considerable size. Millepores have also contributed largely to the coral reefs.

We have now to trace the gradual variation in coral growth as we proceed outward from the shore toward the reef grounds. Here is a rocky ledge, reaching to within about a fathom of the surface at low tide. It is of small size, only a dozen feet each

way, but it affords a good base for corals to grow upon, and the ebbing and flooding of the tides produce about it a constant current of the purest sea water. No locality could be more favorable for marine life. As we approach in our canoe, the first objects that appear are the millepores, sending upward from their shapeless bases the most irregular and fanciful forms, generally in the shape of broad leaves or of ramifying branches ending in finger points. So wild and luxuriant is their growth at times that they partly cover up and obscure the lower-lying heads of more solid corals. But scattered everywhere between them, and over the edges of the ledge, are huge heads of Orbicella, Acanthastræa and Siderastræa, while Mussas and Porites also occur. Other of the shore corals are there too, but from their small size escape our notice in this hasty examination. We see only those larger forms that stand prominently forward, and thus proclaim their great importance in the building of durable structures that may last for all eternity.

This little group of corals, surmounting the rocky ledge, forms a miniature reef; it has only to build upward as far as the water will allow, and fill in the open spaces either with additional growths or with hardened coral sands to possess a true reef structure. Now prolong the ledge with its living top; let it stretch away for several miles and be broadened out to as many yards, and we have a reef such as occurs at times on the Brazilian coast. Unless the coast is sinking the reef soon attains its height and ceases to grow on top, but it may still continue to increase in width. Several of the Brazilian reefs are exactly of this character, having very little height, but from the surface looking like very massive structures. A broad area, presenting favorable conditions for growth, sometimes results in the formation of a wide and irregular coral bank, but such are not common near the shore.

We might now enter into a discussion of the many fringing and other reefs that lie along the coast; but they are all more or less repetitions of one another, are formed in similar ways, and composed of the same corals we have been describing. They are very many in number, occurring in all favorable localities, especially on the coast of Bahia, south of the capital. There is one reef, however, that derives a special interest from the accurate view of it we are able to give, and having been partially raised

Coral Reef of Bay of Bahia.

above the water its growth is nearly finished, so we can trace its entire history from the beginning to the close.

The long island of Itaparica, often called the garden of Bahia, fills up almost the entire south-western quarter of the large Bay of Bahia, and contracts its entrance to a width of about five miles. Its outer coast, running obliquely, faces for the most part the open sea, and is at the mercy of its boisterous waves. Skirting the central portion of this coast for a distance of nearly nine miles, is a slightly elevated coral reef, long since abandoned by true living corals and given over to another class of workers, who are putting on the finishing touches and coating it with a hard and durable substance.

This reef begins directly opposite the city of Bahia, in front of a little rocky point named Jaburú, and stretches away southward, in the general trend of the shore, enclosing behind it a narrow and shallow channel which, at the most, is scarcely one-fourth of a mile in breadth, and generally less. It is most perfect toward the northern end, and has, at irregular intervals, numerous breaks or openings which admit the smaller boats that ply along the shore. Approaching close to Peña, another rocky point about three miles from Jaburú, it ends abruptly; but commencing again just to the south, it runs onward to the Ponte da Cruz, terminating for good on the rocky shore. The study of the geology of the island has shown that the reef follows the submerged, outcropping edges of a series of heavy beds of sandstone, which, at times, bring up on the shore in the form of rocky points. On this solid base the reef appears to have been built, and where, finally, at the south, the sandstone leaves the sea and lies upon the beach, the coral reef ceases to exist.

The reef is slightly zigzag in its course, and both edges are very jagged, deeply indented and bordered by projecting or outlying masses; but so irregular is every part that it would be quite useless for us to try and describe it accurately. At the northern end it is generally elevated on the outer side and low and level on the inner. The higher portion varies greatly in width and height, and is never flattened on top; it rises rapidly, often abruptly, from the water, but descends more gradually on the inner side to a level of about one foot above ordinary low tide. From here there extends inward a very flat surface, which is generally quite broad but may narrow down or even nearly disappear.

Almost everywhere along the inner edge, but more commonly at the ends of the reef and about the openings through it, we find many outlying masses which are often partly continuous with the low, inner surface, but more frequently quite detached. They attain all heights up to that of the lower surface, but never reach above it; the average depth of water around them is between three and four feet. The outliers on the outside of the reef are merely low, ragged, angular projections from the reef itself, and are never much exposed, even at low tide.

Between the two divisions of the reef, the elevated outer portion and the flat inner one, there is the most marked contrast. While the latter has been completely smoothed and rounded off, so that scarcely any angles remain upon it, the former retains all the possible roughness that could be brought together on so narrow an area. The entire raised mass of rock is full of holes of every imaginable size and shape, the margins of which are always acutely angulated. Every little surface that is not pointed in itself is surmounted by a large and strong barnacle with sharply-edged valves, and large clusters of digitate projections stand up at frequent intervals. This combination of surface is a very uninviting one to look upon, but it is far less pleasant to climb over it or walk along its upper part. The outer slope is by far the most irregular, as the waves, aided by an army of sea-urchins, have broken into it and hollowed out thousands of ragged holes, which, lying concealed beneath the seaweeds, might lead to many accidents were the reef more frequented.

The outer portion of the reef is of a dark and rather rich brown color when wet by the waves, but nevertheless has quite a dead appearance. Examining carefully this brown rock, it is seen to consist generally of an accumulation of very small worm tubes, closely packed together and forming a very hard mass. The surface of the low inner level is of a much lighter color, a rather faded brown, and looks even more lifeless than the part we have been describing; no barnacles or other large animals grow upon it.

What forms of life occur about the reef? On the outer side, reaching to a height of a foot or slightly more above ordinary low tide, is a luxuriant growth of seaweeds. Over the same zone, but not so apparent, spread encrusting nullipores, which, though resembling lichens in form, are so highly charged with lime as to

produce a hard coral-like substance. This is one of the most important organisms living on the reef at present, and while aiding to protect it from wear is also building it up. The barnacles and worm tubes of the upper portion we have already referred to, and we have also stated that over the inner surface there seems to be nothing alive. As we enter the many open pools and passage ways of the inner margin there is scarcely more to be seen. Only here and there does a small mass of coral grow, usually a Siderastræa or a Favia. Seaweeds and delicate tufted hydroids and bryozoans hang from the sides of the pools, and a few shell-fish and star-fish lie on the sandy bottom. Small, brilliantly-colored fish dart hither and thither, but the life is not what we are taught to expect about a coral reef.

The features we have so far been giving are those of the northern section of the reef. Going southward a short distance, the elevated outer mass gradually diminishes in size, until it is reduced to a slightly raised border along the seaward margin of a broad and flat reef. Still farther south the entire lower surface, without the raised margin, seems lifted bodily upwards to form a high massive wall, like that of an immense fort, flat above and perfectly square at the sides.

Between the points of Peña and Cruz we find a varied structure, generally, however, only a repetition of the forms already described. The reef is often two or three times as broad as at Jaburú, but near its southern end it becomes very irregular and much broken up, existing as a line of detached reef masses. The passage ways through the reef are sometimes mere simple breaks, cut as squarely and neatly as though the work of man; at other times, however, the edges of the reef bordering them are carried obliquely inwards some distance toward the beach, enclosing a narrow entrance channel. These inner prolongations, although generally low and level, have the same structure as the main reef.

Within the reef the water is always shallow; frequently the bottom lies so high as to be quite exposed at low tide, and it is covered nearly everywhere by a thick deposit of coral fragments, cemented together by carbonate of lime. The corals are not in place but lie heaped together in every conceivable way, as though they had been violently broken from the reef at some former time and thrown inside by the waves. All the commoner forms are there, Millepora, Siderastræa, Orbicella and Mussa being the

most conspicuous, and they are sometimes nearly perfect, but most often broken into irregular masses, large and small. The majority are also coated over with a thin nullipore crust, as though they had been dead a long time before they were swept from their proper dwelling places. This coral deposit has considerable thickness near the middle of the channel and thins out gradually toward the beach.

The extreme southern end of the reef is very low, and near to the beach. It breaks down abruptly on the outer side, but on the inner is bordered by a thick, consolidated layer, which reaches so nearly its own level that it is often difficult to make out the dividing line between the two. A close examination, however, discloses the upright corals in the one and the prostrate fragments in the other.

A great difficulty stands in the way of our determining the intimate structure of this nearly extinct reef, whose outward appearance and surroundings we have so fully discussed. It has evidently not been formed entirely by those agents at present occupying its upper and outer surfaces; but the remains of the real builders, whatever they were, are now entirely covered up and hidden from view, excepting at the one point at the southern end just mentioned. We must resort to artificial sections, no easy undertaking in a coral reef.

Breaking with hammer and chisel into the higher part of the reef, we obtain specimens of a very hard, compact limestone, partly of a nearly homogeneous structure, partly marked by straight or wavy lines of lighter and darker coloring; these two kinds of structure are intermingled with one another without order, sometimes one, sometimes the other predominating. The former has resulted from the masses of serpula tubes—by the complete filling in of their winding cavities and the spaces between them by carbonate of lime, until no trace of the original structure remains. The latter is due to the growth of incrusting nullipores, one thin layer upon another, until quite a thickness of rock has been the result.

It is evident that serpulæ and nullipores were at one time living together over the surface of the reef, and by their combined action has been formed most, if not all, of its outer raised portion, which is sometimes over four feet high and twenty-five feet across. The barnacles are generally broken from the reef when

dead, but are sometimes overgrown by worm tubes and thus become imbedded.

Here and there, the slaves in procuring limestone, have quarried into the low inner part of the reef, and even into the high wall-like portion. Good sections for study are thus formed, and they tell us of what the reef consists. Many large heads of Orbicella, Acanthastræa and Siderastræa stand there exposed in their original positions, and when cut through show their structure to be as open and perfect as though they were still living. With them are many large millepores and nullipores, and all the intervening spaces are filled in with a compact calcareous substance.

Our structure began as a true coral reef, stretching along the submerged rocky ledge. The water was very shallow, however, and the reef soon reached a level above which its corals could not live. Over them nullipores began to grow, but probably while the reef was being raised by other causes than those of growth, large numbers of these dead and partly entombed corals were swept inward by the waves. Nullipores continued to thrive and serpulæ came in to aid them, but with these forms we are already familiar.

Under certain conditions corals begin to grow in scattered patches over the sea bottom, and build up columnar masses which may eventually reach the surface. These columns vary in diameter from two or three feet up to several yards; they are very irregular on top, and covered with living corals. Such structures frequently occur near the shore, generally along the margin of a fringing reef; but their true habitats—where they are best developed—are in the deeper waters of the Abrolhos region, and between there and the city of Bahia. They have also been recorded from Florida and other parts of the world, but on the Brazilian coast they are a much more prominent feature, composing nearly all the larger reef patches.

As one of these coral pillars approaches the surface of the sea, the tendency to upward growth is necessarily destroyed, and the corals living only at the sides build out a rim about it. A mushroom or umbrella-shaped structure, called by the Brazilians *chapeirões*, or big hats, is thus produced. If many such chapeirões occur near together, their ever enlarging rims finally meet, resulting in the formation of a connected reef surface, supported by many upright pillars underneath.

Prof. Hartt, in his "Geology of Brazil," already quoted, has

very fully described the various Brazilian reefs formed by chapeirões, and there is little new to add; but we will take a hasty glance at them in order to complete our sketch. The Abrolhos islands lie some forty miles from the coast, near the middle of the submerged continental plateau, in about latitude 18° south. Surrounding them is a very extended area of constantly warm and pure water, everywhere less than a hundred feet deep. Just to the eastward of these islands is a region, nine or ten miles long and about four broad, over which the pillar-shaped structures are thickly scattered, forming the well-known *Parcel dos Abrolhos.* The chapeirões occur here of all heights and sizes, but never reach the surface, or coalesce to form a continuous reef.

To the north-west of the Abrolhos, and reaching much nearer to the mainland, is the largest reef region of the Brazilian coast, called the *Parcel dos Paredes*, or *Shoal of the Walls.* It is irregular in outline, being about seventeen miles long from north to south, by about nine miles broad in the widest place. Within this area are extensive connected reefs, as well as multitudes of scattered chapeirões. The northern part of the Parcel forms one immense reef, reaching slightly above the level of low tide and formed by the growth of large coral patches and by the coalescing and filling in of chapeirões. This latter feature in reef building has been noticed only on the coast of Brazil. The edges of the reef are very irregular, but the upper surface, laid bare at low tide, is of quite uniform height, although marked by many scattered shallow pools. Running along the margin of this level portion, and separating it from that which is constantly submerged, is a slightly raised border, a foot or less in height, formed by the growth of nullipores, serpula tubes and barnacles. At low water the waves beat against this hard rim, which thus helps to protect the upper part of the reef from wear. The submerged border of the reef dips gently for a certain distance, and then breaks down abruptly to a depth of three to ten feet, meeting a bottom of soft, bluish, calcareous mud which slopes rapidly away, soon attaining a depth of seventy to eighty feet. Chapeirões surround much of this large reef, and extending off southward from it, form two other reefs, the *Recife de Leste* and *Recife da Pedra Grande*, comprising the rest of the *Parcel.*

Several other reef patches, resulting from the growth of chapeirões, occur between the Abrolhos islands and the mainland, and also farther north along the coast of Bahia.

THE FORMATION OF CAPE COD.

BY WARREN UPHAM.

[*Continued from August Number.*]

ON Cape Cod, as on Long Island, Martha's Vineyard and Nantucket, we find, south of the line of morainic hills, an area of modified drift in extensive plains which slope very gently southward. These are fully ten miles wide from north to south in Sandwich, Falmouth and Mashpee, and thence to the east they have an average width of five miles. From the south-west limit of this area at Falmouth village, the traveler who follows the road along the south side of the cape through Waquoit, Cotuit, Hyannis and the south villages of Yarmouth, Dennis and Harwich, sees only level plains twenty-five to forty feet above the sea, with occasional hollows and valleys, most of which are occupied by ponds and brooks. No boulders are seen in this distance of more than thirty miles. They occur, however, in the small hills west of Hyannis harbor, the highest of which is eighty-one feet above the sea, and in lower mounds and ridges two and a half miles south-east at Point Gammon. Shoals of boulders, known as Collier's Ledge and the Bishop and Clerks, lie three miles off shore opposite to these points. Chatham and Orleans, at the east end of this area, are also modified drift, but its surface is very irregularly moulded into hills, ridges and enclosed hollows, the highest elevations being about one hundred and twenty-five feet above the sea. The north edge of this area, next to the terminal moraine, consists of more elevated plateaus, fifty or seventy-five to two-hundred feet in height. From this line there is a continuous slope southward, scarcely perceptible but declining in the five to ten miles of its extent to within twenty-five to forty feet above the sea. This north portion of the plains is marked by frequent hollows of large extent, which contain ponds fifty to one hundred feet below the general surface.

A fine idea of the slope of this deposit of modified drift is obtained in a journey from Sandwich to Greenville, Ashunet pond and Falmouth. The ascent of two hundred feet or more from sea-level to the highest point of the road is accomplished in two miles, bringing us to a point on the road where Bourne's hill, the highest on Cape Cod, is within a half mile to the east, while close at the west is the Great Hollow, about one hundred feet deep and

perhaps a half mile wide, and twice as long from north to south. This is enclosed on all sides by the hills and high plains, but contains no water, showing that the plane of saturation is very deep; while copious springs at the north foot of the hills indicate that it falls in that direction. Without descending more than twenty feet below its highest point, the road next enters upon a plain of gravel and sand, and thence extends seven miles before crossing the first hollow, which is at Ashunet pond. Beyond this point it crosses numerous depressions that are or have been water courses; but there is no break in the continuity of the plains, which in about twelve miles descend by a gradual slope from the height of two hundred feet to sea-level.

These plains of Cape Cod are further like those of Long Island, Martha's Vineyard and Nantucket in being indented by narrow arms of the sea, which reach one to two miles inland, filling the lower end of long depressions that continue across the plains to the north, being either dry or occupied by small streams.[1] The plains and valleys which thus generally border the terminal moraines on their south side appear to have been formed by the same floods which deposited the large amounts of modified drift along the edge of the ice-sheet. Much of their finer gravel and sand was carried forward by the descending currents, and spread in these gently sloping plains, while the valleys of drainage seem to have been made by the same waters at their lower stages.

The continuation of these valleys below our present sea-level calls up one of the most complex but at the same time most important and interesting questions connected with glacial geology. This feature shows plainly that when these valleys were formed the sea did not reach so high upon the land as now; and if we extend our inquiries we find that everywhere around the world the glacial period was marked by most extraordinary changes in the relative heights of land and sea. These remarkable oscillations, which had one extreme at the equator and the other at the poles, appear to have been changes in the level of the ocean. It seems not unlikely that an eighth part of the earth's surface had become covered with ice, and if we consider a slope of one-half a degree to be needed to give it motion, an estimate of four miles for its average depth does not seem to be too great.

[1] These valleys on Long Island have been described by Mr. Elias Lewis, Jr., in *American Journal of Science and Arts*, 3d series, Vol. XIII, pp. 142–146 an 215.

The removal of the water thus taken from the sea and stored up in accumulations of ice would lower the surface of the ocean more than a half mile. At the same time this vast accumulation of ice in high latitudes must draw the sea by gravitation away from the equator toward the poles. This cause appears to have retained the sea-level at about its present height near the lower limit of the ice-sheet, while in arctic regions it rose much higher than now. Marine shells in the modified drift show that the sea thus stood fifty to two hundred feet above its present height on the coast of New Hampshire and Maine; five hundred feet in the valley of the St. Lawrence, and one thousand to two thousand feet higher than now along the west coast of Greenland. Everywhere in high latitudes, both in the northern and southern hemispheres, we have proof of such a submergence of the land when the drift was accumulated, increasing in amount the nearer we go to the poles. On the other hand, the coral islands of the tropics are witnesses of the depression of the sea in this period, amounting to three thousand feet, or perhaps more, at the equator, while different evidence shows that at the mouths of the Mississippi, Ganges and Po rivers it was at least four hundred feet lower than now. If we reflect upon these widespread changes of sea-level that marked the glacial period, occurring only where they would be produced by taking water from the sea to form ice-sheets and by gravitation through their influence, and if we compare these recent simultaneous changes with the general stability of the continents, we seem compelled to attribute them to movements of the sea rather than of the land.

Because of the attraction of accumulations of ice that still remain about the poles, where probably little or none existed in Tertiary times and at the epoch immediately preceding the glacial period, the sea along the eastern coast of the United States appears to be lower now than during those periods, uncovering the Tertiary border of the Southern States and leaving pre-glacial deposits with marine shells, apparently Post-pliocene, fifty to two hundred feet above our present sea-level, under the terminal moraine and modified drift of Long Island. The entirely unstratified character which marks many portions of the terminal deposits of the ice-sheet, reaching quite to the sea-shore, and the still lower extension of the channels which appear to have been cut by the floods formed at its melting, indicate that at the south

coast of New England the sea was depressed in the glacial period below its present height. The submarine channel of Hudson river shows that after this time it sank five or six hundred feet lower than now, apparently because the south part of the glacial sheet had been melted, greatly diminishing its attractive force at this latitude. With the more complete departure of the ice the sea-level has been restored to approximately the same condition as before the glacial period, being still rising on the eastern coast of the United States at the rate of about a foot, or less, in a hundred years.

The channels which we have described as occurring on the plains that slope southward from the series of hills, are best shown on Cape Cod, in Falmouth and eastward to Cotuit harbor, which is the region directly south from the angle of the terminal moraine and from its highest hills, which in this portion of its course are composed mainly of modified drift; in other words, they occur most abundantly where the drainage from the melting ice-sheet must have been greatest, including all the floods poured down from the ice-fields along the line between Falmouth village and North Sandwich, those that converged toward the angle of the ice-margin, and those which brought down its vast frontal hills of gravel and sand along several miles eastward. Some of the hollows containing ponds, which are found frequently on these plains, may have been left unfilled because masses of ice remained there while gravel and sand were rapidly deposited about them; but probably in most cases they are due to unequal deposition, though with unobstructed drainage.

North and north-north-west from the angle of the moraine, a most irregular belt of kame-like modified drift in ridges, hills, plateaus and hollows of every shape, but generally with a north-to-south trend, reaches to Kingston, a distance of nearly twenty miles. These deposits are finely seen along the road from North Sandwich by Great and Little Herring, Bloody and Long ponds. The elevations are fifty to one hundred feet above the depressions, and one hundred to two hundred feet above the sea. The material is obliquely bedded sand and coarse gravel, with pebbles up to one foot in diameter. Boulders are rare or entirely wanting for some eight miles, till we reach Pine and Manomet hills, already described, which seem to constitute a medial moraine of coarsely rocky unmodified drift, accumulated by ice-currents without the agency

of running water. The descending slopes and consequently the currents of the ice on the east and on the west appear to have met here; and when the period of melting came, it was along this belt, extending from North Sandwich to Kingston, that the largest and most heavily loaded rivers flowed down from the departing ice-fields. A great part of their deposits of gravel and sand appear to have been laid down in channels and upon open areas which still remained walled by ice, but when this disappeared they remained in kames or ridges, hills and plateaus, with many enclosed hollows. Telegraph hill, about two hundred and seventy-five feet in height above the sea, and others seventy-five to one hundred feet lower, lying within two or three miles west from the south end of the Pine hills, are probably mostly modified drift, though overspread with frequent boulders up to ten feet in diameter. These are short parallel ridges, with a north-to-south trend, separated by hollows fifty to seventy-five feet below the crests. About Plymouth village the modified drift forms kame-like hillocks and small plains, which are separated by very irregular hollows and valleys. The tops of these deposits have a nearly uniform height, which varies from one hundred to one hundred and twenty-five feet above the sea. Two miles to the west is an irregular series of hills, resembling a terminal moraine, which reaches some three miles westward, varying in height from one hundred and seventy-five or two hundred feet to three hundred and thirteen feet at Monk's hill, in Kingston. Most of these appear to be unstratified boulder-drift, but the top and north side of Monk's hill are waterworn gravel and sand with only few boulders.

In the west part of Plymouth level plateaus and plains of modified drift prevail, broken by frequent hollows of small area with steep sides, containing ponds. These are so numerous that this township is said to have a pond for each day in the year. To the west and north the greater part of Plymouth county consists of similar nearly level or moderately undulating deposits of modified drift fifty to one hundred and fifty feet above the sea. These beds of sand and gravel cover the townships of Wareham, Carver, Middleborough, Plympton, Halifax, Duxbury, Pembroke, Hanson, Hanover, the west part of South Scituate and much of Hingham, reaching continuously from the angle of the terminal moraine of Cape Cod more than thirty-five miles north-north-westward to the

south shore of Massachusetts bay. None of the streams of this region can be supposed to have aided in the accumulation of these materials, instead of which they are evidently carrying away small portions as they gradually deepen and extend their channels. The origin of these plains seems to be due, like the kames of Plymouth, to floods and detritus supplied by the melting ice-sheet which sloped from both sides toward this area. The deposits made in the lower part of the channels of these glacial rivers, between walls of ice, remain as kames, or ridges and hills, composed mainly of coarse gravel, while the portion carried forward and spread beyond the retreating ice-margin forms the nearly level plains.

The only fossils found upon this area are within about a mile south-west from South Marshfield, and were encountered many years ago in digging wells at the houses of Messrs. Kent, Chandler, Wadsworth and Sprague, which succeed each other along a distance of one-third of a mile, the last being in the edge of Duxbury. All these wells showed a surface of modified drift ten to twenty feet deep, enclosing occasional boulders, underlain by a hard ferruginous stratum, six inches to a foot thick, below which were muddy silt, sand and fine gravel, containing successive fossiliferous layers, those at Mr. Chandler's well being four in number, twenty to thirty-five feet below the surface, at heights twenty-five to forty feet above the sea. The fossils include casts of the quohog, long and razor clams (*Venus mercenaria, Mya arenaria* and *Ensatella americana*), and numerous fragments of lignite. The iron-rusted stratum, varying in height from thirty to fifty feet above the sea, and extending continuously at least a third of a mile, seems to represent the depth to which the preglacial deposits were eroded by the ice-sheet, and the lower beds were probably contemporaneous with those at the base of Sankaty Head.

The extreme portion of Cape Cod, north from Orleans to High Head, consists entirely of modified drift. Boulders are very rare, but in two places seem worthy of notice; one of these is about a mile south-west from Nausett Lights, in Eastham, where an enormous boulder, called Enoch's or Great Rock, lies apparently half buried in the sand. The portion in sight is thirty-three feet long, twenty-five feet wide and fifteen feet high. Only two or three other boulders were seen here, none of them exceed-

ing five feet in diameter. The other locality is about a sixth of a mile west from Highland Light, where one block fifteen feet long and several others five feet long occur. In the north part of Eastham the modified drift forms extensive level plains about fifty feet above the sea. From South Wellfleet to High Head, in the north part of Truro, the contour on the west side of the cape is in very irregular small plateaus, ridges and hills, nearly uniform in their height, which varies from one hundred to one hundred and fifty feet above the sea, increasing from south to north. These enclose depressions from twenty to one hundred feet deep, many of which contain ponds. They are also intersected from east to west by broad valleys with steep sides, which have their bottom nearly at sea-level or below it. Examples of these are the hollow which extends from North Truro toward Highland Light, and that of Pamet river, which varies from a third of a mile to one mile in width, and cuts the cape quite across, its bottom, until recently dyked, being marsh overflowed by high tides.

The east side of the cape, through Wellfleet and Truro, is a nearly continuous bluff, one hundred to one hundred and sixty feet high, horizontally stratified, being evidently a remnant of a nearly level plain, the east part of which has been washed away by the sea. This process is still going forward, exposing fine sections of these deposits along most of this distance. The material is mainly sand and fine gravel, with coarse gravel in some portions, containing pebbles and fragments up to one foot or rarely two feet in diameter. Less than a half dozen larger blocks, none of them, however, so large as four feet through, were seen in this whole line of cliffs more than fifteen miles in extent. At the base of these bluffs banks of darkish sandy clay occur in several places, rising ten to forty feet above the shore and extending one hundred to five hundred feet in length. These beds enclose occasional pebbles up to one foot in diameter. At the Clay Pounds, close north of Highland Light, is a massive bed of somewhat similar sandy clay, bluish-gray in color, forty to fifty feet thick, extending a quarter of a mile to the west, as shown by wells, and the same distance along the cliffs to the north, where it gradually thins out. This deposit is finely laminated, level in stratification and free from pebbles. Its base is clearly seen in many places for an eighth of a mile holding a nearly constant height of forty feet above sea-level, and is marked by a hard fer-

ruginous layer one to three inches thick. It rests, by abrupt change, upon gravelly sand containing pebbles up to one inch through, and within ten feet below they occur up to six or eight inches in diameter. The thickest portion of the clay is at the south edge of a gully some thirty rods north of the lighthouse, where the section is gravelly sand to forty feet above the sea; clay fifty feet thick, and sand at top twenty-five feet. The upper part of the clay here and generally, is more sandy than its base, but it is still quite distinctly separated from the overlying sand. A quarter of a mile north the clay becomes narrower, and its base is higher, the section being sand and gravel to sixty-five feet above the sea, clay ten feet, and sand at top fifteen feet. Heights along this portion of the cape are as follows: in Eastham, fifty to seventy-five feet; Lombard's Head, in Wellfleet, about one hundred and twenty-five; highest portion of bluff in south part of Truro, one mile south of Pamet river, about one hundred and fifty; Small's hill, one mile north-east from Truro village, highest point beyond Barnstable on the cape, about one hundred and seventy-five; bluff one mile south of Highland Light, one hundred and sixty; base and focal plane of this lighthouse, one hundred and thirty and one hundred and eighty-five; High Head, about seventy-five.

As in Plymouth county the accumulation of these thick and extensive beds of modified drift, remote from any large river and here bordered on each side by the sea, seems capable of explanation only by supposing the material to have been held in the ice-sheet and deposited by the floods produced at its retreat. When the return of a warmer climate drove back the front of these ice-fields from their terminal moraine upon Cape Cod, the rivers which flowed down from their melting surface were discharged upon these areas, those at the south-west converging upon Plymouth county, while those which descended from the glacial sheet over the west part of the Gulf of Maine had their mouth in Wellfleet and Truro.

The only fossils that have been found on Cape Cod occur in the bluffs on the east shore of Truro, as follows: One mile south from the head of Pamet river the section shows gray sandy clay at base to about thirty feet above the sea; ferruginous gravel, containing broken and worn shells, and with its largest pebbles four inches through, five feet; overlain by more than one hun-

dred feet of sand with occasional gravelly layers. Four to eight rods farther south the clay rises ten feet higher, but at four hundred feet south and at one hundred feet north its top is only twenty feet above the sea. The bed of shelly gravel thins out at three or four rods on each side. Species found here are a *Balanus*, *Neptunea pygmæa* Adams, *Tritia trivittata* Adams, *Lunatia heros* Adams, *Turritella erosa* Couthouy, a *Mya* hinge, *Ceronia deaurata* Gould, *Mactra solidissima* Chem., *Cardium islandicum* L., *Cyclocardia borealis* Conrad, *Astarte undata* Gould, and *Pecten islandicus* Chem. A peaty or lignitic layer, about a half inch thick and extending five feet, was noticed at one place in white sand, three inches above this shelly gravel. A third of a mile north from the head of Pamet river, the bank is about one hundred and twenty-five feet high, consisting of sand with occasional thin layers of gravel, and containing fragments of shells to a height at least sixty feet above the sea. Among these *Ceronia deaurata* and *Pecten islandicus* were recognized. About a mile and a half farther north, or one mile south from Highland Light, the bluffs reach their greatest height, and here worn shell fragments were again found at two localities, a third of a mile apart, occurring in gravelly sand from near sea-level to at least one hundred feet above it. These include *Balanus* species, *Neptunea pygmæa*, *Aporrhais occidentalis* Sowerby, *Acmæa testudinalis* Forbes and Hanley, *Ceronia deaurata*, *Cardium islandicum*, *Cyclocardia borealis*, *Astarte undata* and *A. castanea* Say, *Pecten islandicus* and an *Anomia*. Lignite was observed at the most northern of these localities thirty to forty feet above the sea, in several layers an inch or less in thickness and at least four or five feet in extent. At about the same height the sand and fine gravel here contains clay boulders[1] or pieces of dark sandy clay of irregular shape, and varying in size from three or four inches to two feet long. These are changed to a brown color for a depth of a half inch from the outside, due to oxidation of their iron.

We have already seen that the unstratified character of portions of the terminal moraines, and the channels upon the plains that lie south of them, indicate that in this latitude, during the period when these beds were deposited, the sea stood somewhat

[1] Also found in the modified drift of Long Island, as described by Mr. Elias Lewis, Jr., in *Popular Science Monthly*, Vol. II, p. 634, and in North-western Ohio, according to Prof. N. H. Winchell, *ibid*, Vol. III, p. 202.

lower than now. The occurrence of these recent marine shells up to one hundred feet above the sea, would disprove this conclusion if they lay in an undisturbed condition so as to show that they lived where they now are found; instead of this, they are always more or less broken and worn, no two corresponding valves being found together; and their origin, as well as that of the lignite, clay boulders, and the much older fossiliferous pebbles, next to be described, seems to have been from pre-glacial beds which were formed on the floor of Massachusetts bay. These appear to have been eroded by the ice-sheet, lifted into its mass, and at its melting deposited anew by the glacial rivers, their marine shells being thus embedded in modified drift which was accumulated above the sea-level.[1] The species are of northern range, such as would have been found living in the ocean when it was invaded by the onflowing ice.

A third of a mile north from the last locality, and one half mile south from Highland Light, the bluff rises to a height of one hundred and fifty feet, and consists of sand and gravel, much coarser than usual, having pebbles of all sizes up to one foot in diameter, mostly rounded by water wearing, but a part of them angular, especially the larger pieces, some of which may be two feet long. The foot of the cliffs here is guarded from the waves by several rods of sea-sand covered by beach grass, so that the gravel and sand have fallen down in a steep slope strown with pebbles. Among these are occasional fragments of a whitish calcareous sandstone, thickly filled with shells, which were brought to my notice by Mr. David F. Loring, keeper of the Highland Light. They occur rarely for twenty or thirty rods along the face of the cliff at all heights up to one hundred and twenty-five feet, being most abundant between seventy-five and one hundred feet above the sea. Like the other pebbles, most of these pieces are more or less water worn, some of them being rounded on all sides, indicating that their mode of transportation and deposition were the same; but the stratification is obscured by falling down, so that we do not here find these fossiliferous pebbles actually embedded in the drift. Before seeing any of these specimens,

[1] Marine shells occurring in the till of Scotland are similarly attributed by Croll, Geikie and others, to erosion by the ice-sheet of previously existing marine beds and their transportation to higher levels, so that they cannot be accepted as proof that the sea stood at the height where they are now found. Geikie's "Great Ice Age," 2d edition, pp. 179–181.

however, I had found a fragment of the same shelly rock in the fossiliferous layer of gravel first described, one mile south from the head of Pamet river; and subsequently I found two other bits of it at the most northern locality of shelly gravel and sand last mentioned. These pieces were enclosed in stratified beds, in each case some thirty feet above the sea, evidently occupying their original position in the thick deposits of modified drift which form this part of Cape Cod. The fossiliferous pebbles are thus shown to have been brought to their present place by the same agencies which accumulated these beds of gravel and sand. As no similar formation is known on the land to the north from which they could be derived, it seems quite certain that they represent beds that were in place at the bottom of Massachusetts bay, whence they were ploughed up by the ice-sheet and carried forward and upward in it, till at its final melting they were deposited here.

The scarcity of these fragments is such, that a search of six or seven hours was required, where the whole bank, one hundred and fifty feet high, was plentifully strown with pebbles, to find a dozen of them. These, to the amount in all of perhaps twenty pounds' weight, were presented to the Boston Society of Natural History, and their fossils have been examined by Mr. W. O. Crosby,[1] who regards them as satisfactory proof that the rock is Eocene Tertiary. The species which he has identified are *Camptonectes calvatus* Conrad, found in the Middle Eocene of South Carolina; *Venericardia planicostata* Lamarck, found in the Lower Eocene of Virginia; probably *V. parva* Lea, found in the Eocene of Alabama; and another similar to the common *V. alticostata* Conrad, occurring with the last; probably *Ostrea divaricata* Lea, of Middle Eocene in Alabama, though perhaps young of *O. sellæformis* Conrad, a characteristic species of the Lower Eocene from that State to Virginia; another, principally in fragments, is similar to the recent *O. virginiana* Lister; another species of this genus is represented by fragments of shell fully one and a half inches thick, not enclosed in the matrix of calacreous sandstone like the rest, but found with these shelly pebbles on the cliff a half mile south of the lighthouse, and also in the shelly gravel south of Pamet river; an *Anomia* similar to *A. tellinoides* Morton, of the Cretaceous in New Jersey, Alabama

[1] Proceedings of Boston Society of Natural History, Vol. xx.

and Mississippi; a *Plicatula* similar to *P. filamentosa* Conrad, and an *Axinea*, closely like *A. staminea* Conrad, both of the Alabama Eocene; also probably *Striarca centenaria* Conrad, found in the Miocene of the Southern States. Other molluscan genera that were recognized are *Corbula*, *Cardium*, two species of *Yoldia* or *Nuculana*, several small *Turritella*-like species, and a small *Natica*. Echinoderms are represented by spines of a *Cidaris*, and cœlenterates by a simple cylindrical *Galaxea*-like coral.

In this connection it is interesting to notice that fragments of fossiliferous rock,[1] apparently of Miocene age, are brought up from the sea-bottom on George's Bank, Banquereau and the Grand Bank, by the coralline growths attached to them becoming entangled with fishermen's lines. These, with the Eocene pebbles of Cape Cod, show that the coast of New England, Nova Scotia and Newfoundland, one thousand miles in extent, is bordered by submerged Tertiary formations similar to those which occur above sea-level in the Southern States, as had been already suggested by Prof. C. H. Hitchcock[2] before these discoveries. It was a theory of Agassiz that the fishing banks, from which these Tertiary rocks are drawn up, represent the terminal deposits of drift accumulated at the front of the ice sheet. Both this and the theory of Prof. Hitchcock appear to be true, for besides the fossiliferous fragments many of granites and schists are also obtained by the fishermen. Furthermore the course of the extreme terminal moraine that crosses New Jersey, Long Island, Block Island, Martha's Vineyard and Nantucket has its line of continuation in these remarkable submarine banks, which probably consist, somewhat like Gay Head, of Tertiary strata covered with their own and foreign detritus brought by the ice-sheet.

The moraine of Cape Cod, the Elizabeth islands, Southern Rhode Island and the north shore of Long Island, was formed after the ice had retreated from its farthest limit, but while it still terminated eastward beyond the present coast line. This halt in its departure was extended along the entire margin of these ice-fields to the west, for a distance of more than two thousand miles. Although in the interior of the United States the extreme limit of glacial action has not yet been found to be generally marked by extraordinary deposits, a most notable series of terminal mo-

[1] Described by Prof. Verrill in *American Journal of Science and Arts*, 3d series, Vol. XVI, p. 323.

[2] *Appalachia*, Vol. I, p. 13, and Geology of New Hampshire, Vol. II, p. 21.

raines north of this line and probably contemporaneous with that of Cape Cod is found, as recently shown by Prof. Chamberlin,[1] stretching across Ohio, and represented in Southern Michigan, in the Kettle moraine of Wisconsin, and the Leaf hills of Minnesota; while its farther continuation seems to be in the Coteau des Prairies and the Coteau de Missouri of Dakota and British America, reaching north-westward, according to Mr. G. M. Dawson,[2] to the North Saskatchewan river, three hundred and fifty miles west of Winnipeg lake. These deposits, like the moraines of Southern New England, are made up entirely of drift materials, partly unstratified, with abundant boulders, and partly stratified gravel and sand, in hills one hundred to three hundred feet high, of very irregular contour, with many enclosed hollows and occupying a width of from one to thirty miles. They lie upon the uneven surface of the rocky strata, being continuous across valleys and ranges of highland, which in Wisconsin undulate eight hundred feet in vertical height, while the elevation of this entire series varies from sea-level at Cape Cod, to two thousand feet above it at the north line of Dakota. In the Western States the front of the ice-sheet is shown by Prof. Chamberlin to have been lobed, producing acute angles in its terminal moraine, with medial moraines extending northward from them; corresponding to which we find a deflection of ninety degrees in this series of hills on Cape Cod at North Sandwich with the massive medial range of Pine and Manomet hills a few miles farther north, in Plymouth. The same lobed character appears also to have marked the ice-sheet at its greatest extent, leaving a large driftless area in Wisconsin, and making angles similar to those of a later period in its frontal line, as indicated by the drift-hills of Martha's Vineyard and Nantucket.

The north end of the modified drift of Cape Cod is at High Head; and the whole of Provincetown, at the extremity of the peninsula, consists of sea sand with no pebbles. This sand has come from the erosion by the sea of the east shore of the cape; has been swept north and west by tidal currents to its present place in the lee of this breakwater; lifted by the waves into beach-ridges and further raised by the wind into hills a hundred feet in

[1] "On the Extent and Significance of the Wisconsin Kettle Moraine," in Transactions of Wisconsin Academy of Science, 1878, with maps.

[2] In *Quarterly Journal of Geological Society*, Vol. XXXI, pp. 614–623, with map.

height. From Nausett Lights to High Head much of the cape, as it originally was, has been demolished, and the process is still going forward; but the sea restores a part of what it takes, forming this curved bank of sand, five miles long and one to three miles wide, which encloses the deep and commodious harbor of Provincetown. The section here, to a depth of one hundred and eighty-two feet, was shown by a boring made some twenty years ago at the end of Central wharf. Sand extended from low tide line for thirty-five feet, below which interstratified sand and fine gravel continued to one hundred and seventy feet, where the first clay was encountered. This was dark-colored and very compact, extending twelve feet, at which depth it was not penetrated. Shells of *Scapharca transversa*, *Ostrea virginiana* (at one hundred and twenty feet), *Lunatia heros* and others were found to the depth of at least one hundred and forty feet. Successive generations of these inhabitants of the sea have been buried during this accumulation of its detritus, and at the same time its waters have probably been gradually rising upon the land.

The height of the principal hills of this town, as determined by Major Graham of the Coast Survey, are as follows: Mt. Ararat, one hundred feet above mean low tide; Mt. Gilboa, one hundred and six; Oak Head, one hundred and four; Miller's hill, eighty-nine; High Pole hill, one hundred; Telegraph hill, ninety-eight; Creek hill, eighty-four. These are dunes on the harbor side which have mostly become covered with bushes and trees. Others of nearly equal height, occupying the side next to the ocean, are drifted by every passing wind, allowing no foothold to vegetation; and clouds of sand, seen at the Highland Light, are lifted from this tract by gales to the height of three or four hundred feet.

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THE HILLOCKS OR MOUND-FORMATIONS OF SAN DIEGO, CALIFORNIA.[1]

BY G. W. BARNES, M.D.

THE surface geology of many sections of the Pacific slope is characterized by innumerable hillocks or small mound-like formations, either sparsely distributed or occupying quite densely areas of considerable extent. These formations, variable in size

[1] Read before the San Diego Society of Natural History, April 5, 1879.

and structure in accordance with local conditions concerned in their production, exist in many parts of California and on the coast north of it, and are especially abundant and well defined in Southern California.

The following conclusions are based upon observations of them chiefly in the vicinity of San Diego:

In their most common type the mounds may be described as rounded eminences, or knolls, rising from one to four feet above the surrounding surface or the depressions between them, and ranging from ten to fifty feet in diameter. They are generally nearly circular and distinct, but are, in some instances, confluent or elongated. They are separated by wide and irregular areas or by narrow intervening depressions, the latter containing, in stony places, accumulations of cobblestones. They are confined to no geological structure or quality of soil, and are found on sloping lands, on the higher mesas and lower levels.

Any attempt at an explanation of their origin and the mode of their formation must be based upon the assumption that they are modern modifications of the earth's surface and are due to natural agencies; and evidences abound on every hand that the causes concerned in their production are still active in the formation of new and in the maintenance of the old ones; and hence in this vicinity they may be seen in all the stages of their growth, from small rudimentary cones to the fully developed knolls.

Several agencies acting successively or simultaneously have been concerned in these formations. Each mound marks a spot where formerly grew a shrub or cluster of shrubbery, which served to fix its location and which exercised an important influence in the successive stages of its development. The shrubs which seem to have been chiefly instrumental in these results are the *Rhus laurina*, the *Simmondsia californica* and the *Isomeris arborea*; the former undoubtedly having been principally instrumental in the creation of the more recent as well, perhaps, as the most ancient ones in this vicinity. These plants are fitted for the office they perform by the nature of their growth, which is in compact groups or clusters, with many stems starting from the earth near together, the branches and foliage forming a dense mass resting closely upon the ground, and with beds of massive roots; while the distribution of the groups is strikingly similar to that of the mounds in their typical form and arrangement.

Fig. 1.—Hillocks seen in outline near San Diego, Cal.

Dust set in motion and borne along by the winds is arrested by the shrub and, together with its fallen leaves, accumulate within and around it, and, as is seen in thousands of instances in this vicinity, an elevation of many inches is produced in this manner alone, in many cases covering the lower branches, and in case of the Simmondsia especially, nearly enveloping the whole plant. The gopher, subsisting upon roots and preferring for its operations the loose soil about them, is, in exceptional cases, an adjunct of the wind in heaping up material about the plant. Of the thousands of these clusters of shrubbery which have come under my observation, a very large proportion show unquestionable evidences of these agencies in elevations more or less marked about them, the surface portions of them at least being generally composed of a light loam of dust and decaying leaves. While the loose earth of which the deposit is composed is protected by the branches and foliage of the plant, the more solid earth beneath is also protected from the wash of rain by its massive roots, while all around erosion goes slowly on, facilitated by the peculiar susceptibility of the soil to wash, a quality familiar to the casual observer.

Instances doubtless exist in which the mounds have been more or less fully developed without the aid of those forces which elevate the earth above its original level, but the shrub and the rain wash have been constant factors.

In the course of time the plant dies—is smothered by the drift which nearly covers it, or is destroyed by the fires which annually sweep over extensive tracts of country. Thus deprived of its protection, the winds in turn, and the rains which fall upon it wear down the top of the loose deposit, and to some extent widen its base. While this is going on the surrounding earth, or interspaces, are being continually lowered by the action of water. The wash always being greater at the base than at its summit, its tendency is to perpetually maintain or increase the prominences.

The presence of beds of roots, well preserved as well as in the different stages of decay, within many of the more modern fully formed structures, upon the surfaces of which it is known from observation that no vegetation has grown for many years, is strongly suggestive of a relation between them of cause and effect. In the oldest ones all traces of the original roots have long since disappeared.

A well known effect of timber and shrubbery everywhere is to

impede the drainage of water which falls among it, and so these groups of plants serve to diffuse the currents—which would otherwise be concentrated into gulleys—whose meanderings may be traced in all directions among the mounds, thus conducing to the symmetry of their form and arrangement.

The influence of wash in these results is the most marked on moderate slopes, though sometimes seen on quite steep ones and on comparatively level places, but if upon levels, the latter are so situated as to receive the gathered waters from neighboring slopes. In a situation of this character near at hand the water, after traversing a surface of considerable extent among fully developed mounds, converges into a gully and a surplus flows off to the sea.

Evidences of the potent agency of the winds in results of greater magnitude than these need not be adduced. We need only refer to the sand dunes of Scotland and the shores of the American lakes. It is a matter of common observation here that during the prevalence of one of the "sand storms" of a few hours duration, which visits us once or twice annually, several inches of dust is deposited in places suited for its lodgment, yet the work here ascribed to the wind is mainly carried on by prevailing breezes from the ocean. In situations exposed to concen-

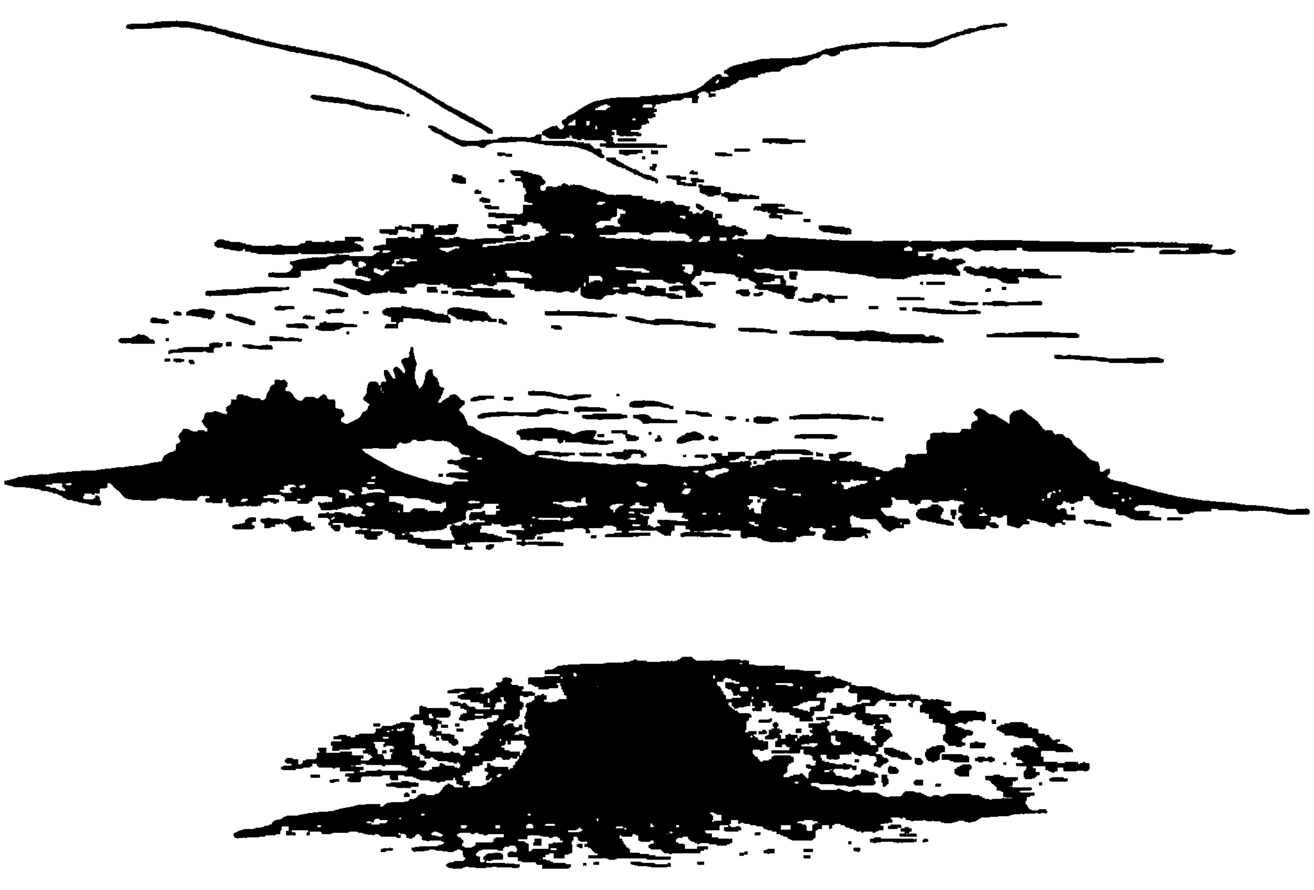

FIG. 2.—Simmondsia with earth heaped about them as in first stage of formation. From nature.

trated wind currents or their sweep over loose earth or traveled roads, the cones are the most sharply defined, showing that in such circumstances the work goes more rapidly on.

As a minor and exceptional agency I may mention that in the

later stages of the formations large excavations are sometimes made by the burrowing of animals, which are afterwards filled with débris, while the matter thus brought to the surface remains to augment the elevation. Hills formed in open spaces by animals do not constitute nuclei for mound-formation; composed as they are of a substratum in which no grass or other vegetable takes root and protects them from dissolution, they crumble away leaving but a bare and level spot.

To recapitulate; in the incipiency of the formation the eleva-

Fig. 3.—Ideal profiles of successive stages of the formations. The dotted lines represent the original surface of the earth.

tion is composed entirely of a deposit heaped often abruptly about the plant (Fig. 2, Fig. 3 *a*), but pretty soon the influence of erosion is manifest in the subsidence of the base.

Next the plant perishes, and, deprived of its protection, the summit is reduced and the base widened as it is lowered (Fig. 3 *b*) till finally a remnant of the deposit has become so assimilated and compact as to constitute a more permanent summit (Fig. 3 *c*), or it has totally disappeared, leaving the summit at or below its original base (Fig. 3 *d*).

Reasons for the appearance of these phenomena so exclusively on the Pacific slope and the arid plains of the West, are that the combination of causes resulting in their production there are seldom found elsewhere, to wit: the growth of shrubbery in compact clusters suitably distributed, with low and dense foliage, the presence of burrowing animals, the great susceptibility of the soil to wash and, I may add, the steady prevalence of winds from a single quarter, and the absence of forests which would otherwise influence winds and surface drainage.

Note.—Since the foregoing was written it has been suggested to me by a gentleman whose opinions have much weight, that the wind exercises an influence in excavating the earth around and between the shrubs of which the mounds are a sequence. While there is no evidence of such action in this vicinity, the explanation doubtless holds good in sections of the country in which a loose or sandy soil prevails. The mounds of this vicinity are found almost exclusively on the upland which, when dry, is quite firm and is not perceptibly acted on by the wind, yet sweeping over a considerable surface it gathers enough of soil, in time, to make large deposits about the shrubbery. Sandy soil is exceptional, and is found usually only in the valleys which are comparatively small in extent. In such situations the suitable vegetation does not so commonly exist, there is more protection from the winds, and the rains, generally light, are so readily absorbed that no surface-wash takes place.

It has also been suggested that pebbles and rocks form nuclei around which accumulations of soil remain and conduce to the production of the hillocks. It must be conceded that this is possible, and in certain qualities of soil and with certain kinds of rock quite probable. In this vicinity, however, in no stage of the process are the stones imbedded in the mounds found to be bare, or protruding, or to hinder in any manner the action of water on the soil; on the contrary, in a soil so easily disintegrated by water, the stones hold their positions by an uncertain tenure, and are so readily rolled from their cavities, as the earth is washed away from them, as to rather facilitate than retard the process of erosion.

INSECT POWDER.

BY WILLIAM SAUNDERS.

THE insect powders of commerce are the powdered flowers of different species of Pyrethrum. Those of *Pyrethrum carneum* and *roseum* were introduced some thirty years ago under the name of Persian Insect Powder, and subsequently those of *Pyrethrum cinerariæ folium*, a native of Dalmatia, Austria, as Dalmatian Insect Powder. Both the Persian and Dalmatian powders are good insecticides, but the latter is much the more energetic in its action and hence commands a higher price; indeed, it is so much preferred that it is gradually driving the so-called Persian powder out of the market. The fact of the flowers of *P. roseum* being less active than those of *P. cinerariæ folium*, has been accounted for on the ground that the single flowers are much more powerful than the double ones, and that the double flowers occur in *P. roseum* in much larger proportion than in the other species. The flowers, either whole or powdered, preserve their activity for a long period. A recent European experimenter states that he could not perceive any particular loss of activity in samples which had been kept six years. The fresh (undried) flowers act very slowly as compared with the same dried and powdered, and the plant itself powdered is quite inactive. It is singular that while there are many other composite plants closely related to the genus Pyrethrum, as yet this peculiar property has been found only in plants belonging to this genus, and even within this limit there are several species whose value as insecticides is very slight. A large number of Compositæ indigenous to Austria have been tested and found to be of no value in this respect. The flowers of Tansy (*Tanacetum vulgare*) are said to have a slight stupefying effect.

The Pyrethrums are hardy plants which bloom abundantly the second year from seed. The powder is prepared from the half-opened flowers gathered during dry weather and dried in the shade under cover, but the process of gathering, drying and preparing involves so much time that their culture can only be made profitable where labor is cheap.

Insect powders have not attracted general attention as insecticides until within the last three or four years, during which time they have been introduced in various forms in packages and

boxes, accompanied by suitable blowers or insect guns for the purpose of properly distributing the powder, and recommended for the destruction of flies, cockroaches, fleas, bugs, &c. Sometimes these prepared articles have been artificially colored so as to disguise their source, but all have owed their activity solely to the presence of the powdered flowers of one or other of these Pyrethrums.

House flies are very sensitive to the effects of these powders. A few puffs of the dust from an insect gun, blown into the air of a room with the doors closed, the discharges directed towards those parts where flies are congregated, will stupify and kill them within a very short time. The powder is somewhat pungent, and to breathe an atmosphere charged with it will frequently cause a slight sneezing, but beyond this the operator need not anticipate any annoyance. Frequently during the past summer, when flies have been troublesome, we have pretty thoroughly charged the air in our dining-room and kitchen at night, closing the doors, and in the morning found all, or nearly all, the flies lying dead on the floors. A few minutes after its use they begin to drop on their backs, and after a very short time die; if a room be closed for half an hour after using the powder, few, if any, will escape. By some this energetic action has been attributed to the presence of a volatile oil in the flowers, by other and later investigators to a peculiar crystalline principle believed to be an alkaloid; but this point does not as yet seem to be fully settled.

More recently we have been experimenting with this powder on the green Aphis which troubles our green-house plants. The usual plan of smoking with tobacco is an unpleasant remedy, and is also very injurious to many plants of delicate constitution, whereas the insect powder, used to any extent, is perfectly harmless to plant-life. After freely charging the air of a green-house with the powder, blowing it in fine clouds of dust among the plants, the tiny tormentors who are busily engaged in sucking the life out of the leaves and tender shoots, soon manifest symptoms of uneasiness and begin to drop from the plants to the ground, and in the course of an hour or two the larger portion of the enemy's forces will be found lying sprawling on the earth in the pots or on the shelves and floor of the house, where, probably partly from the stupefying effects of the powder and partly from their natural inability to find their way to any given point, they fail to

reach the plants again and hence perish. By applying the powder freely in the evening and giving the plants a thorough syringing in the morning, they may in the worst cases be almost freed from Aphides by a single application; it is better, however, to repeat its use the next evening, so as to make sure work. The powder does not appear to kill this Aphis as it does the flies. For the purpose of testing this point we placed a number of them in an open glass cell of a microscope slide and powdered them thoroughly, and found some of them alive after two days of such severe exposure to its influence. Having recently found a plant literally swarming with the green Aphis, so that the sight of it was almost disgusting, we submitted it to the action of this powder one afternoon, having previously spread a large piece of white paper under the plant, so that the effect of the powder on the insects might be distinctly seen. Almost immediately they began to fall on the paper, and in less than ten minutes a hundred or more of them were lying on their backs or crawling sluggishly about. In the course of half an hour some four or five hundred had fallen on the paper, and when the plant was examined again the following morning, there remained but very few on it, and most of these were removed by a slight syringing. We have had the powder used in green-houses by some of our friends, who also report its success. This matter is well worthy the attention of all those who indulge in window gardening or who grow plants in small conservatories attached to dwellings, since if this proves an efficient and economical substitute for tobacco smoke, it will save much annoyance and some loss. Success will necesarily depend on the quality of the material used, but after the experiments we have tried, we feel confident that with good Dalmatian powder there need be no failure. It will be interesting to learn, as opportunity offers, how moths and other insects will be affected by the use of insect powders. If the beautiful specimens which sometimes fly into our rooms at night can be drugged in this way and captured without a struggle, we may add many a perfect specimen to our collections which would otherwise be more or less defaced. There is quite a field for experiment here.—*Canadian Entomologist.*

RECENT LITERATURE.

MIERS' CRUSTACEA OF COREA AND JAPAN.[1]—In this paper are enumerated sixty-four species of Decapods, of which twenty-six are new. Five new genera, *Pleistacantha*, *Pseudophilyra*, *Paratymolus*, *Pornatocheles* and *Heterocuma* are indicated. *Portunus strigilis* Stm., is shown to be *P. corrugatus* Leach, which was well known from the shores of Europe and the Miditerranean. *P. subcorrugatus* A. M. Edw., from the Red sea, is regarded as but a variety of this species, and specimens are reported from Naples. *Paracrangon echinatus*, which previously was only known from Puget sound, is reported from Yedo island. Before beginning the descriptive portion of his article, Mr. Miers has a paragraph on the geographical distribution of the species, in which he notices the affinity between the Japanese Crustacea and those found in the Mediterranean, a similarity which was commented upon by Dana in his chapter on the Geographical Distribution of the Crustacea, in the volumes of the U. S. Exploring Expedition. A similar resemblance is also pointed out between the west coast of North America and Japan. It would seem, however, to the writer, that the true Japanese fauna, as well as that of China, is the most closely allied to that of the Southern United States, and that the resemblances of Japan to Western North America is by means of northern genera, as is that of New England to the coast of Europe. A similar resemblance in the land plants has been pointed out by Prof. Gray in the pages of the NATURALIST. Briefly, our reasons for this opinion are as follows: Crustacea have been described from the coasts of China and Japan belonging to one hundred and sixty-seven genera, one hundred and thirty-six being found in Japan. Now, throwing out all genera which are found only on the eastern coast of the Eastern Continent and the Pacific isles, and also all which are found on both coasts, and we have left forty-six genera with which to show the affinities of the Japanese fauna. In the following table these genera are given with a rough approximation as to their geographical distribution. The writer is fully aware that deficiencies will be found in it, some owing to the lack of literature and others to the fact that the generic limits vary greatly as used by different authors. Old genera have been dismembered and new ones created, and it is not always easy to assign the species described by the older authors to their proper position. This course of genus making and genus splitting has been severely criticised, but one can easily see how in a study of the geographical distribution it aids in showing analogous forms on the various coasts.

[1] *On a Collection of Crustacea made in the Corean and Japanese Seas.* By EDWARD J. MIERS. (Proceedings of the Zoölogical Society of London, 1879, pp. 18–61, pls. I–III.)

GENERA	Japan.	China.	Puget Sound.	California.	Panama.	W. Indies & Gulf of Mexico.	South-eastern United States.	Europe.	Mediterranean.	West Coast Africa.	East Coast Africa.	Indo Pacific Ocean.	Pacific Isles.	Australia.	Brazil.	West Coast South America.	Cape of Good Hope.
Achæus	o							o	o					o			
Oregonia	o		o														
Chorilia	o		o	o													
Schizophrys[1]	o	o							o		o						
Scyra	o		o				o										
Platylambrus	o					o	o					o					
Cryptopodia		o		o		o	o										
Xanthodes	o				o					o							
Ozius	o	o			o	o							o	o			
Achelous	?					o	o				o	o	o		o	?	
Goniosoma	o	o								[2]	o	o	o	o			
Portunus	o						o	o	o	o							
Trichocarcinus	o		o														
Telmessus	o		o														
Heterograpsus	o	o	o	o					o								
Helice	o	o													o		
Pinnixa	o			o			o					o	o				
Thelphusa	o								o	o		o	o				
Philyra	o									o		o					
Ebalia	o						[2]	o	o	o							
Ethusa	o								o								
Dromia	o	o				o											
Latreillia	o								o								
Pachycheles	o			o		o									o	o	o
Polyonyx		o					o										
Cryptolithodes	o		o	o													
Hapalogaster	o		o	o													
Diogenes	o	o						o	o					o			o
Aniculus	o				o								o	o			
Spiropagurus	o					o											
Cœnobita		o			o	o		o	o			o	o				
Galathea[4]	o	o						o	o				o	o			o
Munida	o							o	o								
Scyllarus	o					o		o	o	o		o	o				
Ibacus		o				o						o		o			
Panulirus	o	o		o	o	o	o				o	o					
Astacus		o		o				o									
Paracrangon	o		o														
Hippolysmata		o		o		o	o										
Tozeuma		o					o										
Latreutes	o						o										
Rhynchocyclus[6]	o	o				o								o			
Ogyris	o	o					[7]										
Urocaris	o						o										
Solenocera	o								o								
	38	18	9	9	5	12	14	8	13	7	4	10	9	7	3	1	3

...hrax dichotomus Desm.) is reported by Adams & White in the ...ang from the Philippine Islands; it is a well known Mediterra-... from the Cape Verdes. [2] Desbonne and Schramm report two ...ic position is doubtful. [4] *G. ...* Edw., from Chili, be-... [5] *Angasia ...* Spence Bate, Proc. Zool. Soc., London, ... appears to belong to the genus *Tozeuma*. [6] *Caradina trun-...* ...m Australia, appears to be near this genus. [7] *O. alpha-*

From this table it will be seen that of the forty-five genera noticed, ten are common to the east coast of the Eastern continent and the east coast of America only, four additional have the same distribution, including Australia and the Pacific isles, three are found on both coasts of the Eastern continent and on the eastern coast of America, seven exist only on the shores of the Pacific, eleven belong to the Eastern continent and the Pacific isles alone, four are found on both shores of America but not on the coasts of Europe or the western coast of Africa, three are found on the Pacific coast of America and in Europe, and three on the east coast of America and in Europe but not on the west coast of America. To sum up: of these forty-five genera seventeen are found on the Pacific coast of America, twenty-five on the eastern side, seventeen on the western coast of the Eastern continent and in the Mediterranean. The cases of the Pacific genera which are common to both coasts, e.g., *Oregonia*, *Telmessus*, *Haplogaster*, &c., are in several cases to be explained by the fact that they are boreal genera, and analogous cases will at once suggest themselves in regard to the fauna of the coasts of the North Atlantic. The cases of *Liomera luta*, which has been reported from China, the Pacific islands and C. St. Lucas, *Cœnobita rugosa* from the Indian ocean, Australia, the Pacific, and of which there are specimens in the Museum of the Peabody Academy of Science from Panama, and of *Platyonichus bipustulatus* from New Zealand, Japan, India and Chili, are paralleled by similar facts in the distribution of *Leptopodia siggitaria*, *Litinia dubia*, *Xantho vermiculatus*, &c., which are found on the eastern shores of the Atlantic. Another fact to be noticed in comparing the fauna of Japan and the eastern seas with that of the Atlantic coasts of America is, that certain genera which are peculiar to one region are represented in the other by allied forms, for example, *Leptopisa*, *Panopeus* and *Eucratopsis* of the American waters are represented on the Asiatic coasts by *Tiarinia*, *Heteropanope* and *Eucrati*.

An examination of Gunther's Fishes shows a similar identity in the genera of the eastern coasts of the two continents, but in Edmund Perrier's article on the Geographical Distribution of the Asteridæ no such similarity can be noted. It is my desire to carry out the investigation of this resemblance further, and any facts or references bearing on the geographical distribution of marine forms will be very acceptable, and due credit will be given therefor.—*J. S. Kingsley*, *Norwich*, *N. Y.*

BRONN'S CLASSES AND ORDERS OF THE ANIMAL KINGDOM.[1]—This famous series of six volumes is now drawing to a close, the

[1] *Dr. H. G. Bronn's Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild.* Fortgesetz von Dr. A. GERSTÆCKER. Fünfter Band. Gliederfüssler. Arthropoda Lieferung 1–27. Leipzig und Heidelberg, 1879. 8vo, with many lithographic plates.

volumes on birds and Crustacea being apparently nearly completed, the Molluscs and Radiates having been published several years ago. The work is a compilation from numerous memoirs and papers, being encyclopædic in its nature, and the most authoritative, complete general account of the different classes and orders of the animal kingdom to be found. The plates are filled with figures, chiefly anatomical and developmental, from the memoirs and works of the leading authors, and are, in general, excellent copies. The present work on Crustacea is done in Dr. Gerstæcker's best style. The last part is taken up with the Trilobites, which are treated of with great thoroughness and copiousness of illustration. Though a somewhat expensive work, it is invaluable as a work of reference, and we call attention to it because of its great usefulness to any one living out of reach of extended libraries.

BAIRD'S ANNUAL RECORD OF SCIENCE AND INDUSTRY.[1]—This is one of a series of eight yearly volumes which fills a place in popular scientific literature not occupied, and will prove to be a very useful compendium of annual progress in science in Europe and this country. Reference to the index, which by the way is an admirable one, will show how many items are inserted in this well packed book, and just how fruitful the year 1878 was in scientific discoveries, whether of pure or applied science. The number who have assisted the editor are thirteen. This volume is of the same nature as the one issued for 1877, having a less number of pages than those from 1871 to 1876, owing to the omission of abstracts of scientific papers, for which it was impossible to find sufficient space. We have noticed the series in former years, and now recommend it as reliable, condensed, most useful and, in short, indispensable to teachers and editors as well as to the general reader.

RECENT BOOKS AND PAMPHLETS.—Notice of Recent Additions to the Marine Fauna of the Eastern Coast of North America, No. 5. By A. E. Verrill. (Brief Contributions to Zoölogy from the Museum of Yale College, No. XLII.) (From the American Journal of Science and Arts, Vol. XVII, June, 1879.) 8vo, pp. 3.

Notice of Recent Additions to the Marine Fauna of the Eastern Coast of North America, No. 6. By A. E. Verrill. (Brief Contributions to Zoölogy from the Museum of Yale College, No. XLIII.) (From the American Journal of Science and Arts, Vol. XVIII, July, 1879.) 8vo, pp. 3.

Preliminary Check-list of the Marine Invertebrata of the Atlantic Coast, from Cape Cod to the Gulf of St. Lawrence. By A. E. Verrill. (Prepared for the U.S. Commission of Fish and Fisheries.) (Author's edition, June, 1879.) 8vo, pp. 32.

Report of Work of the Agricultural Experiment Station, Middletown, Conn., 1877–8. By W. O. Atwater. (Taken, in part, from the Report of the Secretary of the Conn. Board of Agriculture for 1878,) 8vo, pp. 172.

The North American Entomologist. No. 1, Vol. 1, July, 1879. Editor, A. R. Grote. Publishers, Reinedse, Zesch & Baltz, 500 Main street, Buffalo, N. Y. 8vo, pp. 8, 1 plate.

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[1] *Annual Record of Science and Industry for 1878.* Edited by SPENCER F. ‑with the assistance of eminent men of science. New York, Harper & ‑79. 12mo, pp. 715.

Mollusca of H. M. S. *Challenger* Expedition, Parts I, II and III. By the Rev. R. Boog Watson. (Ext. from the Linnæan Society's Journal—Zoölogy, Vol. XLV.) London, 1879. 8vo, pp. 39.

Outlines of Field-Geology. By Archibald Geikie, LL.D., F.R.S. 2d edition, revised and enlarged, illustrated. 12mo, pp. 216. Macmillan & Co. 1879. From the author.

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Drainage Map, showing a portion of Wyoming, Idaho and Utah. Primary triangulation, by A. D. Wilson. Topography, by Henry Gannett, G. B. Chittenden, G. R. Bechler and F. A. Clark. (Depart. of the Interior, U. S. Geol. and Geog. Survey of the Territories, F. V. Hayden, U. S. Geologist-in-charge.) From the Department, Washington, 1879.

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A General Catalogue of the birds noted from the islands of the Lesser Antilles, visited by Mr. Fred. A. Ober, with a table showing their distribution, and those found in the United States. By Geo. N. Lawrence. (Ext. Proc. U. S. National Mus., 1879.) 8vo, pp. 3. Washington. From the author.

Colonial Museum and Geological Survey of New Zealand. Thirteenth Annual Report on the Colonial Museum and Laboratory, together with a list of the donations and deposits during 1877–78. Jas. Hector, M.D., F.R.S., director. 8vo, pp. 40. Wellington, New Zealand, 1878. From the directors.

The Utica Slate and related formations. Fossils of the Utica Slate and Metamorphosis of Triarthrus Becki. By C. D. Walcott. (Printed in advance of Vol. X Trans. Albany Institute, June, 1879.) 8vo, pp. 38, pls. II. Albany, 1879. From the author.

The Local Geology of Davenport [Iowa]. By Rev. W. H. Barris. 8vo, pp. 261–288, pls. X, XI. (Ext. Dav. Acad. Nat. Sci., Vol. II, Sept., 1878.) From the author.

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The Oölogist: a monthly journal devoted to the study of Birds and their Eggs. 8vo. Vol. IV, No. 9, April, 1879. Utica, N. Y. From the editor.

Hand List of Mollusca in the Indian Museum, Calcutta. By Geoffroy Nevill, C.M.Z.S., &c. Part I. Gastropoda Pulmonata and Prosobranchia—Neurobranchia. 8va, pp. 338. Calcutta, 1878. Printed by order of the trustees. From the superintendent of the museum.

Bolletino Scientifico redatto dai dottori de Giovanni Achille, Maggi Leopoldo e Zoja Giovanni, Professori all' Universita di Pavia. Anno I, Num. I. 8vo, pp. 16. Milan, 1879. From the editors.

GENERAL NOTES.

BOTANY.

On the Fertilization of Symplocarpus fœtidus.—Belonging to the Aroidæ, and possessing at once an odor unpleasant to man, and a spathe of a brownish or reddish-purple color, the "skunk cabbage" would probably be taken at first sight as a good example of what Müller calls a loathsome flower—a flower which by its color and odor repels all insects save carrion-loving flies and beetles, and whose fertilization, if dependent upon insects at all, must depend upon those of this kind. From the partly closed spathe it might be further inferred that this is a good example of a plant in process of transition from the state of a completely open loathsome flower, like *Calla palustris*, to that of one in which the spathe has been so modified by natural selection as to be converted into what Müller would call a kettle trap, as is the case with *Arum maculatum*, the object of such a trap being to detain any insects which enter the spathe until they shall have performed the office of fertilization for which they were enticed into it. If a few of the largest spathes are secured in the first warm days of spring they will probably be found already in bloom, and a moment's inspection will show us that the flowers clustered on the stalked globose spadix are proterogynous; for while the delicate stigmas of some are protruded from the floral envelopes, their stamens are still enclosed and immature. It will also be found that the flowers which are open are those situated near the top of the spadix. These flowers, then, are ready to be fertilized, but pollen for their fertilization must be brought from another spadix. In the course of a week or two, for the rapidity of development depends in large part on the warmth of the season, the aspect of our spadix will have entirely changed, for the stigmas of the upper flowers will be withered and the stamens of these same flowers will now protrude from their envelopes and shed their pollen. Meantime the stigmas of the lower flowers have matured, and some can evidently be fertilized by the mere falling of pollen from the upper flowers without any extraneous aid, for pollen is shed in such quantities that it covers the bottom of the spathe.

On the first warm and sunny day we repair to a sheltered swampy place where we find our plant, and proceed to look for the little flies that we expect to find in the spathes, whither they should be attracted by the color and odor, and by the shelter offered; but no flies appear. While we are looking a hive-bee alights on a spathe and enters it. Approaching, we see her busily engaged in collecting pollen, meantime creeping back and forth over the surface of the spadix, which, as well as her body, is thoroughly covered with the yellow dust. Other observations show that each spathe is daily visited by scores of hive-bees,

some of which are unable to escape from the spathes and die there. A little later in the season a small bug (Hemipter) may be found in small numbers on the spadices, and they are usually well dusted with pollen. Occasionally a slug or the slimy trail of one is found within a spathe, and usually they pass over the spadix. A couple of weeks after finding the first bee the spathes will be found swarming with the minute black flies that were sought in vain earlier in the season, and their number is attested not only by the hundreds of them which can be seen, but also by the many small but very fat spiders whose webs bar the entrance to three-fourths of the spathes. During the present spring a few specimens of a small scavenger-beetle (*Ips fasciatus*) have been captured within the spathes of this plant. What they were after I can scarcely say, but they may have been visiting spathe after spathe in search of one with a decaying spadix, for the prolonged cold and wet weather caused many to decay, or they may have been in search of flower-food.

Considering these facts, it appears that with us hive-bees are not deterred by the odor of the flowers from visiting them and collecting their pollen, and that their visits are so frequent as to render them the chief agents in securing the cross-fertilization of the flowers, at least very early in the season. Later a few bugs and beetles may be of some use in transferring pollen, as also in a slight degree the spiders which take up their abode within or at the entrance of the spathes. Slugs and snails enter as agents for the transfer of pollen in a few cases, as might be expected from what Delpino has shown with regard to their habits in visiting plants related to this. Finally, other and more attractive flowers opening, the bees appear to cease visiting those of this species, and countless small flies take their place, compensating for their small size by their great numbers.—*William Trelease.*

Botanical News.—To the *Bulletin* of the Torrey Botanical Club, Mr. N. L. Britton contributes notes on the relative age and dimensions of a number of different trees. Dr. G. Engelmann farther notices the differences between *Vitis riparia* and *cordifolia.* The death of Dr. Rugel, in Tennessee, an excellent botanical collector, is announced.——Vol. VI, Botany of Lt. Wheeler's Report upon U. S. Geographical Surveys west of the 100th meridian, consists of "Reports upon the botanical collections made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the years 1871–75," by Dr. J. T. Rothrock, who has been aided by Messrs. Engelmann, Porter, Watson, Bebb, Vasey, Boott, Eaton, James and Tuckerman. Fifty new species are described and mostly figured. The catalogue is preceded by chapters on the botany of the Colorado district, the New Mexican district, and on Economic Botany. Prof. Eaton's report on the Ferns of the South-west relates to all the ferns hitherto discovered in the regions of the United States lying

west of the 105th degree of west longitude, and south of the 40th parallel.——In the *Botanical Gazette* for July, Mary C. Reynolds notices at length certain Floridian ferns. E. T. Smith notices a new form of *Trillium grandiflorum* from Michigan. A writer over the initials C. R. B. calls attention to the neglected botany of West Virginia.——Fritz Müller questions, in *Nature*, whether many of the varieties of bananas have not been produced by bud-variation.——In the *Mittheilungen* of the Natural History Society of Bern, Herr Frankhauser contributes a paper on the most important conditions of shape in the leaf of phanerogamic plants, and a second one on the principal laws of growth in Florideæ, and Dr. Pertz notices some luminous bacteria.——In an important memoir on the ovule of plants, Prof. Warming discusses the early development of the leaf or "ovular mamelon," the genesis of the nucleus and the formation of the integuments of the mamelon. According to a reviewer in *Nature* he demonstrates that the theory of Brogniart as to the morphological significance of the ovule is the true and solely admissible one, and he reasons very conclusively against the views of Bronn, Eichler and Strasburger, who would regard the ovule as a bud, while in reality, as he says, "the ovule is the homologue of a sporangium."——Mr. L. Lesquereux contributes an article on Cordaites bearing fruit (with a plate) to the Proceedings of the American Philosophical Society.

ZOÖLOGY.[1]

DOES THE FOX SNAKE "MIMIC" THE RATTLESNAKE?—On May 24th a fact came under my observation which until then was unknown to me; it may, however, not be new to other readers of the NATURALIST.

While examining an exposure of lower magnesian limestone in the glen at the Junction mill, my attention was called to a large spotted snake lying upon the stump of a fallen tree, where it was stretched at full length basking in the sun over the stream. Before I could reach the spot the snake had apparently suspected danger and had retreated to a clump of grass near the foot of a tree where, by diligent search, it was at last discovered. Desiring to obtain the specimen alive, if possible, I placed my foot upon the body of the snake near the middle, when, to my surprise, there followed a buzzing sound that caused me to spring backward, thinking I had encountered a rattlesnake.

A blow from a stick disabled the snake but did not stop the buzzing sound, which was repeated several times, and the motion of the tail was distinctly observed by myself and my friend, Mr. F. F. Watson. The terminal inch and a half of the tail alone participated in the vibration, and was thrown rapidly from side to

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

side over an arc of about three-fourths of an inch, moving so rapidly as to appear like a dull fan-like glimmer. In every instance observed the tail was raised but little above the horizontal, and the buzzing sound was continuous through a few seconds only.

Is this to be called an example of "mimicry"? May it be said that far back in the past some sagacious ancestor witnessing that act of intimidation on the part of the rattlesnake, and observing how successful it was, resolved to adopt the practice itself; and thus, through inheritance, the practice became engrafted upon this species? If so, that ancestor, it would seem, must have possessed a keenness of perception, an accuracy of judgment and a depth of reasoning human-like in a high degree, and far above what is usually recognized among the members of its class.

If the fact under consideration is not an example of "mimicry," may it be said that some ancestor in one of its battles accidentally moved its tail from side to side so rapidly as to produce a strange buzzing sound that frightened its antagonist away; that that snake possessed the sagacity to connect the flight of its enemy and the buzzing sound with the rapid motions of its tail; and that by continued repetition of this feat in subsequent battles, there were wrought structural and mental changes sufficiently fixed to be inherited?

If all this be granted, and it is very unsatisfactory reasoning to me, we have possibly a clew to the beginning of differentiation in the tail of the rattlesnake.

There can be but little doubt but that the specimen under consideration is the fox snake, *Coluber vulpinus*, although I have at hand only the abbreviated description found in Jordan's "Manual of Vertebrate Animals."—*F. H. King, River Falls, Wis., May* 26, 1879.

Breeding of Land-locked Salmon.—Land-locked salmon, in the Schoodic waters (Maine) are occasionally found filled with ripe spawn in the spring. This seems a curious circumstance in fish which normally spawn in the autumn months, and perhaps may be considered a case of retarded development. In our own experience we have never seen melt in the male fish at this out-of-season, and it would seem as if it but needed the concurrence of retardation in the two sexes, and their coming together, in order to change the breeding habits of the species. What is curious, if a general fact, the instinct of propagation in these untimely fish seems inferior to that instinct which governs their habits of life. Normally, during the breeding season, these salmon seek the rapid streams, but these spring fish, filled with spawn, are found in the waters of the lake along with others of their species. In order to give directness to this statement we would state that, for one instance, on June 2d we took from the

lake a large healthy fish which extruded into the boat apparently healthy eggs as large as peas, and more were afterwards forced out in abundance by gentle pressure. In the young fry from last year's hatching, the yolk sac was scarcely absorbed at this time.—*E. Lewis Sturtevant, M. D., S. Framingham, Mass.*

NOTES ON AMERICAN CRUSTACEA.—Having recently been studying the Crustaceans belonging to Union College, kindly loaned me by Prof. H. E. Webster, I have thought best to place on record some of the more noticeable features of the collections. I hope, however, at an early day to publish a more extended notice. Enough specimens were found to show the identity of *Othonia anisodon* with *O. aculiata* (Gibbes) Stm. A new species of *Actæa* (*A. spinifera*) occurred from Plantation Key, Fla. This species closely resembles *A. hirsutissima* (Rüppell) Dana, from the Indian ocean and the Red sea, and differs from all other American species in the character of the antero-lateral teeth, which closely resembles those of *A. hirsutissima.* Prof. Webster collected specimens of *Panopeus* of the two forms described as *sayi* and *texanus*, but I can find no constant character to separate them; the coloration of the hand and presence or absence of the sub-hepatic tubercle certainly are not sufficient characters. A comparison of the young of *Hepatus decorus* with *H. tuberculatus* Saussure, as suggested by Stimpson, reveals the fact that the two species are distinct. A new species of *Lithadia* (*L. lacunosa*), allied to *L. cariosa*, was found at Sarasota bay, Florida. It differs, however, from that species in the ornamentation of the carapace, which is covered with circular depressions like those on a lady's thimble. Among the Anomura were specimens from North Carolina and Florida of the curious *Euceramus prælongus* Stm., which resembles a *Hippa* in form, but is allied by its structure to the porcelain crabs. A new species of *Pisosoma* (*P. glabra*) comes from Key West. It differs from *P. rüsei* in the simple not bimarginate front. *Polyonyx macrochelis* and *Lepidops venusta* were found at Fort Macon, N. C., adding two species to the fauna of that locality in addition to those mentioned in my list (Proceedings Philadelphia Academy, 1878, pp. 316–330). Among the Macrura the most noticeable was a species of *Ogyris* (*O. alphærostris*) from Northampton county, Virginia (Eastern shore, Atlantic side.) This species differs from the only other known one, *O. orientalis*, in having a rostrum like that of *Alphæus heterochelis*, and the absence of a dorsal carina on the carapace. The eyes are slender and elongate, strikingly like those of Hippa. A peculiar interest attaches to this and certain other genera of Crustacea (*Tozeuma*, *Urocaris*, *Rhynchocyclus* and *Limulus*) from the fact that the known species inhabit the eastern coasts of the two continents, while the western shores have no representatives of these genera. A similar fact in geographical distribution has been noticed in the flora. Specimens of *Alphæus minus*, from

Florida, were the largest I have ever seen, one measuring forty-five millemetres in length.—*J. S. Kingsley.*

THE BELOSTOMA PISCIVORUS.—Having some stickle-backs in a jar of water I was surprised at finding one or two of them dead, though hardy. Soon afterwards, however, I saw a large water-bug (Belostoma) seize one of these fish, pierce it with its strong beak, and apparently suck the fish's blood.—*Henry Turner, Ithaca, N. Y.*

EARLY STAGES OF THE OYSTER.—Certain of the early stages of the oyster have been studied in Europe, but a complete history is much needed. Prof. W. K. Brooks is now engaged on this subject at Crisfield, Maryland, where he has established the Summer Zoölogical Laboratory of the Johns Hopkins University in connection with the U. S. Fish Commission. He had succeeded May 20th in artificially fertilizing the eggs, ascertaining that the process of segmentation occupied two hours, and that in six hours free-swimming ciliated embryos are produced.

THE MAIOD CRABS.[1]—Mr. Miers has given in this paper a revision of the families, sub-families and genera of this interesting group of Crustacea. The genera enumerated number 106, and are placed in four families, Inachidæ, Maiidæ, Periceridæ and Parthenopidæ, founded on characters derived from the orbits and antennæ. The families as given by Dana in the Crustacea of the U. S. Exploring Expedition, were shown several years ago to be faulty, and in the present state of our knowledge of this group, the arrangement proposed is generally good, and will prove indispensable to the student. The pages of the NATURALIST are not the place for an extended examination of this system of classification, but it may not be out of place to notice a few of the points, errors and omissions of the paper. The generic name *Podonema* is preoccupied (as *Podinema*) in the Reptilia, and I would here propose the name *Coryrhynchus* in allusion to the hood-shaped rostrum; it includes three species from Florida, *riisei*, *hypoglypha* and *lamelligera*. The genus *Oncinopus* DeHaan, for which Dana established a separate group, is assigned to the neighborhood of Irachus. The placing of *Chorinus* and *Macrocheira* in the same section hardly seems proper, nor does the separation of Schizophrys and Cyclax from the neighborhood of Mithrax and Mithraculus. The placing of Libinia and Cœlocerus in different families is, we think, hardly right. A character separating *Mithrax and Mithrachulus* which is not noticed in this paper is that in Mithrax the anterior margin of the meral joint of the external maxilliped is notched for the reception of the succeeding joints, while in Mithraculus it is entire. The generic

[1] *On the Classification of the Maiod Crustacea.* By EDWARD J. MIERS. (Journal of the Linnæan Society of London—Zoölogy. Vol. XIV, 1879.) Pages 634–673, pls. XII and XIII.

name *Microrhyncus* is preoccupied, and Alphonse Milne Edwards has proposed in its stead the name *Neorhyncus*.

THE ROCKY MOUNTAIN LOCUST IN NEW MEXICO.—During a recent trip to New Mexico to investigate the southern limits of the distribution of *Caloptenus spretus*, I was enabled to ascertain a number of new facts regarding the extreme southern limits of this species. According to Ex-governor W. F. Arny, of Santa Fé, small swarms of destructive locusts, supposed to be this species, have appeared at a point 140 miles south of Santa Fé. Heretofore the U. S. Entomological Commission had been unable to trace it south of Taos, N. M., where it was known to have been destructive in 1877. From Ex-governor Arny and several Mexicans and Pueblo Indians we obtained the following facts, which are of general interest. In 1868 the counties of Valentia and Bernalillo were troubled by locusts. They probably came from the north-west as they do generally, and without doubt breed in the eastern portions of Arizona lying west of Valentia county, N. M. In 1865 they were seen near Santa Fé, and the wheat crop of the Pueblo Indians of Pojuaque was totally destroyed by locusts which came from the north-west. In 1868 the same Pueblo was visited late in the season. In 1871 Santa Fé, and in 1874 Santa Fé and Rio Ariba counties, including several Pueblo Indian towns, were invaded. In 1873 Colfax county was visited, and a few appeared the next year. In 1877 Santa Fé and Taos counties were invaded. The swarms at Santa Fé came from the west or south-west, in July, and passed up into Rio Ariba and Taos counties, crossing into Costilla county, Colorado. From these facts it seems that the northern half of New Mexico, and probably Northern Arizona, are occasionally subject to invasions of locusts from Southern Colorado; but the flights are sporadic and local, and occur after the wheat crop has been mostly harvested. Whether on account of droughts or locusts, or from both causes, the Pueblo Indians have, like the Egyptians of old, been in the habit of laying up stores of wheat and corn two and three years in advance.—*A. S. Packard, Jr.*

ZOÖLOGICAL NOTES.—We take the following notes from late numbers of *Nature*: Dr. Fritz Müller has sent from Brazil a trichopterous insect belonging to the *Leptoceridæ*, remarkable on account of its showing, very distinctly, branchia such as have lately been discovered in the imago state of this group by Dr. Palmèn.——M. Jourdain has read a paper before the French Academy on the respiratory apparatus of *Ampullaria*, a fresh-water mollusk.——The muscles of crayfish have been studied from a physiological point of view by M. Richet, the muscles of the clam have a high degree of contractibility.——M. Sörensen, in his studies on the apparatus of sound in various South American fishes, finds that vibrations are communicated to the air of the

swimming bladder.——The fauna of the Solomon islands has been discussed by Mr. E. P. Ramsay, several new birds being described; 120 mammals and about fifty species of insects were collected for the Australian Museum, of which Mr. Ramsay is the collector.——The fossil head of a *Rhinoceros ticorhinus* has been found in Siberia in a good state of preservation.——Another fossil mammoth has been found at Newburgh, N. Y.——The metamorphoses of the cantharides (*Lytta vesicatoria*) from the egg has been worked out by M. Lichtenstein, of Paris.——The body-cavity of sedentary Annelids has been studied by M. Cosmorici, and the anatomy of an Actinia, *Cerianthus membranaceus*, has been investigated by Von Heider.——The genus Squilla is now know to date as far back as the London clay, and Mr. Woodward, the discoverer of the fact, describes *Necroscilla wilsoni*, a supposed stomapod Crustacean from the middle coal measures, and a fossil king crab (*Limulus*) from the cretaceous formation of the Lebanon.——Collections of birds have lately been examined by London ornithologists, from the Argentine Republic and the United States of Columbia, the latter collection comprising 3500 specimens, representing 469 species.——A collection of land shells, of which ten or twelve are supposed to be new, collected by the late Dr. W. M. Gabb, in Costa Rica, has been reported on by Mr. G. F. Angas.——A young hippopotamus has lately died in captivity of trichinosis.——Immense swarms of butterflies have been witnessed at Le Mail and in Alsace, June 8th and 10th, and June 7th in Zurich.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The first number of *Matériaux* for 1879 is one of unusual interest to the general reader. On page 22 is a report of a discussion before the Geological Society of London, on the mammoth in space and time. On page 31 is given a series of stone implements from Japan. On page 33 M. Maret presents the results of diggings in the grotto of Placard, Charent. Figure 18 represents a cresent-shaped implement from the horn of the reindeer, use undetermined. We beg to suggest that the object is drawn upside down, and that it resembles very closely the bone deadeyes used on Eskimo Kyaks for running lines; in other words it is the parent of our modern block for tackle. On page 46 we have the announcement of the meeting of the Congrès international d'Anthropologie et d'Archeólogie préhistorique at Lisbon, in 1880, and the programme of M. Daly's Course of Ethnology for 1880, at the School of Anthropology in Paris, as follows:

1. Les sciences anthropologiques. Définitions. L'ethnologie et l'ethnographie. Eléments statiques et dynamiques.

Sources de l'ethnologie. Anatomie et physiologie individuelle

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

et comparative. Caractères tirés de la coloration de la peau, des cheveux, et des yeux, du crane et du squelette. La taille. Langage et langues.

2. Sources de l'ethnologie (*suite*). Les voyages. L'histoire. Les traditions. Mythes et légendes. L'architecture. Les produits industriels.

Définitions relatives à l'espèce, à la race, aux variétés, aux familles, aux nationalités. Hérédité, Atavisme.

3. Distribution des races humaines. Eléments des classifications. Chap. x de la *Genèse*. Essais de classifications: Bernier, Linée, Buffon, Blumenbach, Virey, Cuvier, Lesson, Bory Saint-Vincent, Desmoulins, Latham, Isidore Geoffroy, Nott et Gliddon, d'Omallius d'Halloy, de Quatrefages, Huxley, Hæckel.

4. Classifications récentes: Triciologie. Crâniologie. Les types anthropologiques abstraits.

5. Ethnographie — Type éthiopique et ses dérivés. Races africaines. Races océaniennes.

6. Les négres d'Afrique. Sénégambie. Guinée. Gabon. Angola. Benguela.

7. Le Soudan. La Nubie. Le Haut-Nil. Les lacs. Résultats ethnologiques des récentes explorations de l'Afrique centrale. Ugandi, Niams-Niams et M'bouttous.—Akkas. Zulus.

8. Race bantou ou cafre. Bechuanas. Bassoutos. Makalolos Mozambique. Zanzibar. Somali, Gallas. Les Koï-Koïn et Hottentots. Avenir de la colonisation africaines.

9. Les colonies de nègres esclaves. Etats-Unis d'Amérique. Les Antilles. Le Brésil. Libéria. Inaptitude collective des nègres. Croisements des races noires africaines.

10. Races noires de l'Océanie. Negritos. Papous. Australiens. Races noires de l'Inde et de l'Indo-Chine. Les Weddahs. Les Mincopies.

11. Le type mongolique et ses dérivés. Branche turco-mongole. Les Mongols, Les Turcs. Les races boréales. Samoyèdes. Ostiaks. Kamtschadales. Aléoutiens.

12. Branches sinique et thibétaine. Races de la Chine et de l'Indo-Chine, du Thibet et de la Birmanie. Civilisation chinoise.

13. Branche malaisienne. Les Malais. Les Howas. Les Japonais. Aïnos. Carolins. Aptitudes civilisatrices.

14. Les Polynésiens.—Origine. Migration. Civilisation. Extinction prochaine.

15. Branche américaine. A. du Sud. Race ando-péruvienne. Quichuas et Aymaras. Les Antisiens. Les Araucans. Les Fuegiens. Race pampéenne. Les Patagons. Les Charruas. Race brazilio-guaranienne. Botocudos. Tupis, Mocovis. Mundurucus.

16. Races préhistorique de l'Amérique du Sud. Civilisation des Incas. Races indigènes de l'Amérique centrale et du Mexique. Civilisation mexicaine. Les Antilles. Etat présent des races de l'Amérique latine.

17. Amérique du Nord. Creeks et Cherokees. Comanches. Dacotahs et Sioux. Algonquins. ·Hurons. Iroquois. Californiens. Apaches. Yakis. Papagos. Athapascans, Chinooks. Nookta-Colombiens. Répartition et condition présente des indigènes de l'Amérique du Nord. Territoires indiens.

18. Les races françaises du Canada. Les races européennes aux Etats-Unis. Acclimatement. Fécondité respective. Effet général des croisements européens, nègres et indigènes. Les Chinois en Amérique.

19. Esquimaux et Koloscheş.

20. Le type caucasique. Les Iraniens. Les Hindous. La légende aryenne. Populations dravidiennes de l'Inde. Les Castes. Brahmanisme, Mazdéisme et Bouddhisme. Afghans. Belouthes. Persans.

21. Races syro-arabes. Le Sémitisme. Les Phéniciens. Les Juifs. Les Chaldéens. Les Arabes. Les Abyssins.

22. Races caucasiennes. Géorgiens. Mingréliens. Arméniens.

23. Races méditeranéennes. Les Egyptiens. Civilisation nilotique. Pélasges et Hellènes. Etrusques. Races indigènes de l'Afrique septentrionale. Berbères. Touaregs. Kabyles.

24. Ethnologie de l'Algérie. Acclimatement respectif des immigrants. L'Algérie, la Sénégambie et le Gabon.

25. Races préhistoriques et proto-historiques de l'Europe. Races de Caustatt et de Cro-Magnou. Les Ibères. Les Ligures. Les Basques. Les Italiotes.

26. Les Goths. Les Cimbres. Les Germains. Invasions mongoliques. Celtes et Germains. Slaves.

27. Etat actuel de la domination ethnique. Colonisation. Population. Aptitude militaire.

28. Ethnologie.—Récapitulation. Tableaux comparatifs de la distribution des races humaines à diverses périodes. Les origines. Unité ou pluralité primitive du genre humain. Hypothèse dun' cantonnement primitif. Influence des milieux; altitude, température, climat, etc.

29. Théories diverses sur le transformisme et le spécifisme, de Maillet, Lamarck, Wallace, Darwin. Extinction des races inférieures.

30. Des croisements ethniques. Races croisées. Races mêlées. Leur valeur comparative. Résultats généraux et spéciaux du métissage. Mariages consanguins.

31. De la civilisation: Le langage. Geste et mimique. Chant. Langage articulé. La nourriture: plantes comestibles sauvages. La culture. Le feu. Préparation des aliments. Le sel. L'anthropophagie. Les armes. Les outils. Le développement de la civilisation est lié au perfectionnement des armes et des outils. La domestication des animaux. Le vêtement. Funérailles.

32. Transmission des idées. Le nombre. L'alphabet. L'écri-

ture. Le dessin. La gravure et la peinture. L'imprimerie. La sténographie. La musique. · L'harmonie.

33. L'organisation sociale. La famille. Le mariage. Polyandrie. Polygamie. Position des femmes dans la société. Les Castes. La hiérarchie. La guerre. L'esclavage.

34. Mythologies et légendes. Religions. Philosophies. Conceptions diverses du Cosmos. Le fétichisme. Culte des pierres, des arbres, des animaux. Astrolâtrie. Chamanisme. Sacrifices humains. Polythéisme. Monothéisme. Rationalisme. Athéisme. Positivisme. Répartition ethnique des croyances religieuses. Atavisme religieux.

35. Mutilations et déformations ethniques. Déformations du crâne, du pied, des oreilles, du nez, de la bouche. Eunuchisme. Ovariotomie esthétique. La circoncision. Colorations. Ornamentation.

36. Les migrations. Lois générales de l'accroissement et du décroissement de la population. Epidémies. Pathologie comparative des races. Famines. Alimentation comparée des races. Rendement musculaire.

37. Causes générales des migrations. La conquête. La chasse. La pêche. L'épuisement du sol. La navigation. Phéniciens. Grecs. Arabes. Commerce des esclaves. Métaux précieux. Excédant de population. Evénements politiques. Colonies pénitentiaires.

38. Aptitude ou inaptitude des races à la civilisation. Relations du milieu géographique avec le développement. Fertilité du sol. Rivières, îles et continents. Civilisations interrompues. Civilisations disparues. Emprunts réciproques.

39. Chronologie comparative. Conditions de la perpétuité de la civilisation. Création du droit. Evolution des idées morales, esthétiques et scientifiques. Théorie ethnologique du progrès. Théorie physiologie.

40. Portée utilitaire de l'ethnologie. Conflits modernes des races. Colonisation. Migrations futures. Prévisions ethnologiques.

GEOLOGY AND PALÆONTOLOGY.

A REMARKABLE NEW GENUS OF GIANT SLOTHS.[1]—This memoir describes the skull of a new species of Megatherium-like animal, which Dr. Reinhardt has called *Grypotherium darwinii*, from the pleistocene of the Argentine Republic, and which has been presented to the Museum of Zoölogy of the University of Copenhagen by Dr. V. Lausen, together with a large number of the remains of other animals from the same place. The skull of this Megatheroid is of great interest, for whilst it is unmistakably to be referred to that group of animals, it presents a singularity not found in any other recent or fossil sloth.

[1] *Beskrivelse af Hovedskallen af et Kæmpedovendyr, Grypotherium darwinii, fra La-plata-Landenes plejstocene Dannelser.* Af. J. REINHARDT. (Ext. Videns. Selk. Skr. 5te Raekke, Naturvidens. og Math. Afd. XII, 4. 4to, pls. II.) Kjöbenhavn, 1879.

The skull is that of an old animal, as the sutures are almost entirely obliterated. Its length is .610 m. (a little more than two feet), which would make the creature, when alive, intermediate in size between *Megatherium americanum* and *Mylodon robustus*, and therefore belonged to one of the largest forms of the family yet discovered. The most remarkable feature of the cranium, and one which is without a parallel in the family, and hence at once distinguishing it from all allied forms, is the singular structure of the muzzle. The intermaxillary bones are completely coössified (owing, perhaps, partly to the age of the animal), and rise vertically upon the median line in the form of a buttressed bony arch to unite above with the anterior extremity of the nasal bones, which extend forwards beyond the anterior extremities of the maxillaries, resulting in a structure remotely resembling the same parts in *Rhinoceros tichorinus*, and in the absence of an osseous nasal septum, more notably that of *R. merckii*, in which the bony nasal partition is only partially ossified. There is abundant evidence to show that this arch is not a part of the nasals prolonged forward, since there is a suture separating the latter from the intermaxillaries proper. The structure, however, in this animal is not nearly as strong as in *R. merckii*, an explanation of the strength of whose nasal bones is clearly to be sought in the fact that these were surmounted by immense horns which it probably used with great effect; as to whether or not the nasals were armed in *Grypotherium*, there is nothing to indicate, at present at least, that they supported a weapon of any sort.

The presence of the intermaxillary arch undoubtedly entitles Prof. Reinhardt's species to generic rank, in fact there can be little doubt of the propriety of dividing the *Megatheriidæ* provisionally into two new groups, the extinct genera *Mylodon*, *Scelidotherium*, *Megatherium*, *Megalonyx*, *Cœlodon*, being forms typical of—

a. Aphelorhinæ; with unspecialized intermaxillaries.

b. Diarhinæ; with intermaxillaries vertically produced and joined by suture to the anterior extremity of the nasals, and dividing the external nares as in *Grypotherium*.

The intermaxillary arch dividing the external nares, but without an osseous nareal septum, recalls the arrangement of the bones of the muzzle of certain lizards, more particularly those of *Iguana*.

The tooth formulæ of some of the extinct genera may be compared as follows:

Scelidotherium and *Mylodon*..............................	molars	$\frac{5-5}{4-4}$
Grypotherium..	"	$\frac{4-4}{4-4}$
Cœlodon...	"	$\frac{4-4}{3-3}$

forming a series which exhibits very nicely a process of gradual reduction in the number of teeth.—*J. A. Ryder.*

A NEW SPECIES OF CŒLODON.—Prof. Reinhardt's contributions to our knowledge of the poorly known genus *Cœlodon* established in 1839 by Dr. Lund for the reception of a Megatheroid, the remains of which were obtained by the latter author in the bone caves of Brazil, are also noteworthy. The memoir[1] deals with the remains brought by Dr. Lund to Copenhagen, but not fully described and figured by him. The skull in the present paper is well represented, and valuable figures are given of the feet of *Cœlodon escrivanensis*, based on the remains of the young individual found in the last cavern, la Lapa de Escrivania, which Dr. Lund explored in 1844, whilst the name *C. maquinensis* Lund, is retained for the species represented by teeth found in la Lapa nova Maquiné by that explorer in 1835. The *C. escrivanensis* was about the size of the large South American ant-eater (*Myrmecophaga jubata*), and in the opinion of Dr. Reinhardt was most nearly allied to *Mylodon*, and in some respects to the existing arboreal *Cholœpus*. Its habits, the same authority thinks, were arboreal, and he looks forward with much interest to the discovery of an extinct type which seems to us dimly shadowed forth in *Cœlodon*, and which will connect the fossil Megatheroids with the existing species of sloths. To us there is much evidence to show that the history of these animals—their succession in time and their descent—will yet be as completely worked out as that of the horse, dog and camel.—*J. A. Ryder.*

GEOGRAPHY AND TRAVELS.[2]

AFRICAN EXPLORATION.—Dr. Rohlfs writes from Djâlo (southeast of the Sella or Zeila oasis), on the 8th of April last, that he left Sokna on the 11th of March. Up to that point the traveler passed over a new route, partly through a desert country, and also through two hitherto unknown oases, Abu-Naïn and Djebbena. This region abounds in fossils of every kind, Ammonites, Echinidæ and others. "There is probably no other district in the world which is equally rich in its extinct marine fauna." Dr. Stöcker has sent home an accurate topographical survey of the Djofra oases on the scale of 1 : 100,000. These three oases, Sokna, Hon and Uadan, are bounded by ranges of hills to the north and south—the highest peak is Gannassa, 2000 feet above the sea-level. Owing to the fanaticism of the natives, Dr. Rohlfs was badly received at Djâlo, and has been unable to procure a guide on account of the unfriendliness of the Bengasine government. Dr. Stöcker has returned to Bengasi to try to favorably

[1] *Kæmpedovendyr Slægten Cœlodon.* Af J. REINHARDT. (4to, p. 257–349, pls. 7. Ext. Videns. Selsk. Skr. 5te Raekke, Naturvidensk. og Mathem. Afd. XII, 3.) Copenhagen, 1878.

[2] Edited by ELLIS H. YARNALL, Philadelphia.

influence the rulers of the country and enable the expedition to proceed to Kufra, the next oasis in their journey to Wadai.

Mr. Donald Mackenzie has established a station at Cape Juby on the north-west coast of the continent, and made a treaty with a powerful native chief, by means of which it is hoped a large and important trade with North-central Africa will be opened up.

M. de Semellé has now returned to France, and states that he followed the course of the Niger from Omtcha as far as Boussa, a distance of 300 miles, and the Benué as far as Oku (?). He has collected much information on the products of the country, and concerning the history and traditions of the people. Daily meterological observations were taken.

M. Soleillet has also returned home, and in a recent address speaks highly of the intelligence and peaceable character of the Sultan and population of Sego. The Niger at Sego, 2000 miles from its mouth, is 300 yards wide.

The Rev. S. I. Comber, of the Baptist Missionary Society (English), has left England to found a station at San Salvador, situated about 100 miles south of the Congo and 200 from the coast. He hopes ultimately to reach Stanley Pool above the falls of the Congo, and launch there a small steamer which is to be taken up in sections. The Royal Geographical Society has supplied him with instruments.

Dr. Buchner, one of the German African Society explorers, has been detained by the rainy season at Cassange, on the Quango, before going on to the capital of Muata Yanvo's kingdom.

Maj. Mechow, another member of this expedition, will attempt to descend the Quango river from Cassange until it joins the Congo, where Stanley identifies it with the Ibari Nkutu.

Maj. Serpa Pinto, on his arrival in Lisbon, delivered a lecture on his recent journey from Benguela to Natal. This address has been fully reported in the daily press of England and America, but being unfortunately very vague and rambling in character, we are glad to quote from the London *Athenæum* (July 19, 1879) the following notice of his work as explained by him very recently to a company gathered at the house of the president of the R. G. S., in London: "The new ground traversed by Maj. Pinto is comprised between Bihé, in the interior of Benguela, and a place called Lialué, in the 'Barotse valley,' passed by Livingstone on his journey northward along the Zambesi towards St. Paulo de Loanda. Thus defined, the new country which the Portuguese explorer has opened up, is about five hundred miles broad from north-west to south-east. The blank space is traversed on Livingstone's map by a number of rivers set down from native report, and the names have turned out generally to be correct, although the courses of the rivers are wrongly given. The great merit of Maj. Pinto's exploration lies in the accurate definition of these rivers, and the fixing of all important points by astronomi-

cal observation. Arrived on the Upper Zambesi, his route led him along regions previously made known by Livingstone and other travelers. Maj. Pinto, however, made excursions near the confluence of the Chobé to ascertain the true hydrology of the region before striking south-eastward. He then made for Soshong, the capital of the Bechuana country, and crossed the little known westerly portion of the Transvaal on his way to Pretoria and Natal, continuing his survey as he went, and adding most materially to an accurate knowledge of the geography of the less known districts."

"As geographical results of the highest importance must be mentioned first his longitudes. Maj. Serpa Pinto performed the feat of carrying three chronometers, one of which, by Dent, kept excellent time across the continent. Their indications were checked by astronomical observations, including the transit of Mercury, eclipses and occultations, which have been proved exact; and thus there are no grounds for doubting the remarkable conclusion which he draws, that Soshong is placed on our maps more than a degree *west* of its true position—a conclusion which necessitates the shifting of the Limpopo a degree to the east and narrowing our territory in the Transvaal to a corresponding amount."

"Next in importance is the light he has thrown on the topography and physical geography of the region along the southern border of the Benguela highlands. Lieut. Cameron, who traversed these highlands on his journey from east to west, established the fact that the succession of terrace formed coast ranges of Western Africa here broadens out into a lofty plateau. Pinto devoted much of his time and attention to this interesting region. He visited the sources of many of the rivers rising on this water shed, traced and mapped them; and afterwards, part of the courses of two of them, which flow south and south-west towards the lower lying region bordering the Kalahari desert. On the Benguela plateau, at an elevation of 5800 feet, is situated the central native town of Bihé, peopled by a race of Boer traders and travelers, parties of whom annually traverse the whole western interior. A little west of this, within the space of a few yards, rise four great streams which flow respectively north-west and south-west to the Indian ocean, east to the Zambesi and south to Lake Ngami. Pinto's journey southward and eastward from Bihé led him to the upper waters of the Cubango and its tributaries, and the Quando. The Cubango (visited in its lower course by Andersson and called by him the Okavango) he satisfied himself has no connection with any other stream, and discharges its waters in the inland basin of Lake Ngami. But the Quando, a much less known and far more important stream, after gathering the drainage of numerous large tributaries, flows for several hundred miles as a navigable river and enters the Zambesi, its lower course

being the stream made known by Livingstone under the erroneous name of Chobé.

"Maj. Pinto did not descend these rivers for any great distance, but struck across their upper waters. He had by that time exhausted his means and was reduced to the verge of starvation in a district of swamps inhabited by a light-colored race of savages allied to the Bushmen. He consequently made for the Zambesi by the nearest route, and eventually succeeded in struggling through to the less barbarous settlements further south. He has submitted all his maps and astronomical observations, and his well kept barometrical register to the inspection of competent judges in London."

The other division of the Portuguese Expedition, under Messrs. Capello and Ivens, arrived at Cassange in December, 1878. Since leaving Bihé in November, 1877, they have explored a part of the river Quango. When last heard from (April 5, 1879) they were on the margin of the river Lucala, examining the country traversed by the Cubango. They had already explored that river from its source to 8° S. lat.

MICROSCOPY.[1]

CONTAGION AND THE GERM THEORY.—One of the best of the "American Health Primers," now in course of publication by Lindsay & Blakiston, of Philadelphia, is the little treatise upon "Long Life and How to Reach it," by Dr. J. G. Richardson. As might be expected, from the name of the author, those parts of the subject which have been fields for microscopical work, are treated with marked interest and ability. The germ theory of disease, in which the author seems to have become an earnest believer, is explained in a very simple and plausible manner, and is made the text for much sensible advice as to the means of avoiding contagious diseases, including those which are communicated by public drinking cups and toys, such as whistles and toy balloons, which are touched to the lips after having been similarly used by other people. Very valuable, too, are the conclusions in regard to purifying and disinfecting infected articles or localities; and the folly is once more pointed out, which it seems as if people never would learn, of believing a place to be disinfected because it has been made to smell badly of some reputed disinfectant.

THE MICROSCOPE IN ENTOMOLOGY.—The illustrated paper on the anatomy of *Amblychila cylindriformis*, by Mr. Carl F. Grissler, of Brooklyn, published in recent numbers of *Psyche*, is so full of philosophical spirit and of fine microscopical work, that it will interest many who are not entomologists and to whom the Cicindelidæ would be new acquaintances. This thorough and system-

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

atic study, with its fine plate drawn on stone by the author himself, is a good example of how the microscope ought to be used. Microscopists will be similarly interested in the study of the structure of the tongue of the honey bee, by Prof. J. D. Hyatt, in the last, July, number of the *Amer. Quar. Mic. Journal.*

MANDIBLES OF ANTS WORN BLUNT BY USE.—"Much interest has lately been developed, in the Cambridge Entomological Club and in the Entomological Section of the Boston Society of Natural History, by discussions which owe their origin to the statement published by Rev. H. C. McCook, that the mandibles of ants are worn off and become blunted by the labor which they perform. It has been thought that Mr. McCook was mistaken, that the chitin of the mouth parts of insects remained as it had been upon emergence from the chrysalis, and that the forms of mandibles observed by Mr. McCook were monstrosities. In confirmation of the wearing away of mandibles, Mr. E. P. Austin exhibited, at the last meeting of the Entomological Section of the Boston Society of Natural History, nearly a hundred specimens of *Pasimachus*, in which all the fresh, bright-looking specimens had perfectly-shaped sharp mandibles, while those specimens which were old and worn in general appearance presented every gradation of bluntness of the mandibles. Communications on this subject, based on observation, would be acceptable to the Cambridge Entomological Club."—*Psyche.*

AMERICAN QUARTERLY MICROSCOPICAL JOURNAL.—For the first time we are inclined to find fault with this new journal. The July number contains several good natural history articles and a variety of interesting notes on aperture, illumination, &c. The portion with which everybody will be disappointed is the announcement that its publication will cease with. the present number. This will leave us once more without an American periodical devoted to the publication of elaborate memoirs upon microscopical subjects. The journal has already acquired a character and name too valuable to be lost, and it is to be hoped that the editor and publishers will be induced to reconsider their decision to abandon the enterprise.

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SCIENTIFIC NEWS.

— We take pride and pleasure in drawing attention to the appreciative manner in which British naturalists testify to the nature of work recently done in this country in ornithological bibliography, and trust that the desired results may be brought about.

Memorial to Elliott Coues, Esquire, Assistant Surgeon United States Army.

We, the undersigned, beg leave to express our high appreciation of the "Bibliographical Appendix" to your work, "Birds of the Colorado Valley," being No. 11 of the Miscellaneous Publications of the United States Geological Survey of the Territories, under the charge of Dr. Hayden. And at the same time we wish to place on record our gratitude to that gentleman and to the authorities of the department to which you are attached, for the liberality they have shown in granting you permission to stay at Washington for the completion of this and other important works upon which you have now been so long and so usefully engaged.

The want of indexes to the ever increasing mass of zoölogical literature has long been felt by all workers in every department of that science; but the enormous labor of compilation has hitherto deterred many from undertaking a task so appalling. It is with no small satisfaction that we recognize your readiness to devote yourself to work of this nature. Moreover, we feel justified in hoping that should the installment now published in the volume above named be enlarged in a similar manner so as to include a complete bibliography of ornithology, this branch of science will possess an index to its writings, perhaps more complete as to its scope and contents than any kindred subject of similar extent.

An undertaking of this sort is beset with formidable difficulties; not only is its extent enormous and the works relating to the subject are widely scattered through many libraries, public and private, but the qualifications of a good bibliographer are not easily to be found united in one person. His application and industry must be untiring, and he must be thoroughly conversant with the art of bibliography. In addition to these requirements, in a case like the present, an equally thorough knowledge of the subject under consideration is indispensable. You happily combine all these qualifications; your industry has long been approved, your knowledge of books is evident from what you have now put before us, your knowledge of ornithology has long been known to us. We can well believe that the libraries of your own country are better stored than any others with works relating to the ornithology of North America, and that, therefore, the "List of Faunal Publications relating to North American Ornithology" could be nowhere better prepared than in Washington; but when the ornithological literature of the whole world has to be examined, it seems to us almost indispensable that the older libraries of Europe, and especially of England, France, Italy, Germany and Holland should be consulted if one of the chief merits of your work is to be maintained, viz: The consultation at first hand by yourself of every work mentioned therein.

This brings us to one of the chief objects of this memorial,

which is to express our sincere hope that time and means will be found you to prosecute in Europe the great undertaking you have commenced so well, and bring it to a successful conclusion. Should the authorities who preside over the department to which you belong—and especially the Surgeon-General of the United States Army—who have hitherto so liberally granted you facilities for the scientific work you have performed, be disposed to furnish you with these means of perfecting your undertaking, we are convinced that it will reflect great credit to them and the country to which you belong. We on our part, so far as England is concerned, are ready not only to welcome a brother ornithologist, but also to render you every assistance in our power.

[Signed.]

W. H. Flower, F.R.S., etc., President of the Zoölogical Society of London.
T. H. Huxley, Sec. R.S.
Charles Darwin, F.R.S.
St. Geo. Mivart, F.R.S., Sec. L.S.
Alfred R. Wallace.
A. Günther, F.R.S., Keeper of the Department of Zoölogy, British Museum.
Philip Lutley Sclater, M.A., Ph.Dr., F.R.S., Secretary to the Zoölogical Society of London.
Alfred Newton, F.R.S., V.P.Z.S., Prof. of Zoölogy in the University of Cambridge.
H. B. Tristram, F.R.S.
Osbert Salvin, M.A., F.R.S., Editor of *The Ibis.*
F. Du Cane Godman, Secretary of the British Ornithologists' Union; and twenty-six others.

— Recent arrivals at the Philadelphia Zoölogical Garden: 1 English blackbird (*Turdus merula*); 1 Angora goat (*Capra hircus* var.); 4 barn owls (*Strix flamea americana*); 1 sandhill crane (*Grus canadensis*); 1 ring-necked snake (*Diadophis punctatus*); 2 Virginia deer, twins (*Cervus virginianus*), born in the garden; 2 electrical eels (*Gymnotus electricus*), South America; 2 red-crested cardinals (*Paroaria cucullata*), South America; 14 lizards (*Sceloporus undulatus*); 2 mule deer, twins (*Cervus macrotis*), and 1 fallow deer (*Dama vulgaris*), born in the garden; 7 mandarin ducks (*Aix galericulata*), China; 1 rose-crested cockatoo (*Cacatua moluccensis*); 5 banded rattlesnakes (*Crotalus horridus*); 1 wild cat (*Lynx rufus*); 78 finches of the following species—cutthroat finch (*Amadina fasciata*), spotted munia (*Munia undulata*), Maja finch (*Munia maja*), black-headed finch (*Munia malacea*), sharp-tailed finch (*Munia acuticauda*), amaduvade finch (*Estrelda amaduva*), orange-cheeked finch (*Estrelda melpoda*), bicolored finch (*Amadina bicolor*); 1 elk (*Cervus canadensis*), born in the garden; 2 short-eared owls (*Brachyotus palustris*); 13 opossums (*Didelphys*

virginiana), born in the garden; 2 collared peccaries (*Dicotyles torquatus*), born in the garden; 1 common gannet (*Sula bassana*); 1 pine snake (*Pityophis melanoleucus*).

— Phosphorescence appears in the flesh of marine animals along with a gelatinous substance which is formed. With the microscope (according to MM. Bancel and Husson) one finds two kinds of germs; at the surface-cells which no doubt produce this mucous fermentation, and in the mucus very small bacteria. The cells are thought to act like plants, decomposing carbonic acid of the air by day, fixing the carbon and liberating the oxygen in the liquid. By night they liberate carbonic acid, and the germ then lives and causes destruction of the matters round it, condensing oxygen and producing carbonized and phosphorized hydrogen. The hydrogenized products being burnt as they are produced, cause the phosphorescence. The author considers the phosphorescence of the lobster due to a fermentation of the kind referred to.

Apropos of phosphorescence, M. Nuesch records in a recent number of the *Journal de Pharmacie*, some curious observations regarding luminous bacteria in fresh meat. Some pork cutlets he found illuminated his kitchen so that he could read the time on his watch. The butcher who sent the meat told him the phosphorescence was first observed in a cellar where he kept scraps for making sausages. By degrees all his meat became phosphorescent, and fresh meat from distant towns got into the same state. On scratching the surface or wiping it vigorously, the phosphorescence disappears for a time; and the butcher wiped carefully the meat he sent out. All parts of the animal, except the blood, acquired the phenomenon over their whole surface. The meat must be *fresh;* when it ceases to be so, the phosphorescence ceases, and *Bacterium termo* appear. None of the customers had been incommoded. It was remarked that if a small trace of the phosphorescent matter were put at any point on the flesh, of cats, rabbits, &c., the phosphorescence gradually spread out from the center, and in three or four days covered the piece; it disappeared generally on the sixth or seventh day. Cooked meat did not present the phenomenon, but it could be had in a weak manner from cooked albumen or potatoes. No other butcher shop in the place was affected. The author is uncertain whether to attribute the complete disappearance of the phenomenon to the higher temperature of the season, or to phenic acid, or to fumigation with chlorine.—*English Mechanic.*

— In "Notes on *Pterygocera annaricæ*," by Carl Bovallius (Kgl. Svenska Vet. Akademien Handlingar, Bd. 4, No. 8, 1878), we have a very full account of this interesting form of Amphipod, on which the author bases a new sub-family. The author also gives

in a foot-note a short account of Martinus Slabber, the original describer of the species, which we copy:

"Martinus Slabber was born in 1741, probably at Middleburg. In 1767 we find him elected a member of the Hollandische Maatschappye der Wetenschappen. He was then called 'Bailleuw en Secretaris te Baarland en Bakendorp, en Secretaris te Oudeland.' In 1769 he was a member of 'Zeeuwsch Genootschap der Wetenschappen te Vliessingen. In 1793 keeping the above named charge, he seems to have removed to the town Goës, where we find him in 1807 as 'Raad der Stadt.' He died in Gravenpolden in 1835, aged 94 years. All these places are situated on the isle of Walcheren."

A list of his published works, six in number, is also given. Slabber, we would here note, was the first to figure the zoea of Crustacea.—*J. S. K.*

— Locusts are reported as doing much damage in Southern Russia in June; also swarms of locusts appeared in North-west India, by advices received in London, in April. Swarms of locusts have likewise recently appeared in Armenia; news from Elizabethpol states that both the banks of the river Kur were completely covered with the insects as far as Terter on the one bank, and as far as Akstafa on the other. All vegetation is devastated.

— In a posthumous paper by Frederic Smith it is stated that the general aspect of the Hymenopterous fauna of the Hawaiian islands is North American, with admixture of a few South American forms. The ants are most diverse in character, some being cosmopolitan in range. The house ant of Madeira is common, and the little European ant (*Ponera contracta*) also occurs there.

— The well known British entomologist, Frederick Smith, assistant keeper of the Zoölogical Department, British Museum, London, died Frebuary 16, aged 72.

— Prof. Lawrence Smith has been elected by the French Academy, correspondent in mineralogy, in room of the late Sir Charles Lyell.

— Dr. Page, Prof. of Geology at Durham, died at his residence, Newcastle-on-Tyne, lately. Prof. Page was a voluminous writer on geology and the physical sciences. He was long connected with Messrs. Chambers, of Edinburgh, and many years ago his name was a good deal associated with the scientific basis of the well-known book, "The Vestiges of the Natural History of Creation."

— Prof. Huxley has lately avowed his belief in the fungoid origin of certain diseases, as may be judged by the following extract from a recent address reported in the *English Mechanic*: "The fungi were the greatest destroyers of useless matter. Nature did her best to get rid of this matter. Death was said to

be one of the causes of putrefaction, but this was not quite true, and it would be more correct to say that life was the cause of putrefaction. If they took proper precautions to keep away from any dead body the organisms he had mentioned, it would not putrefy, and the sole cause of that most disagreeable change called putrefaction was the introduction of a particular form of life more analogous to the fungi than anything else, known as Bacteria. It was only lately that they had known much about them. The *Bacterium termo* was not more than a 30,000th part of an inch. If they took a small portion of fluid of putrefying matter they would find millions of them in every drop, darting about as if they were fishes. They multiplied with enormous rapidity, and after a certain period of activity passed into a period of rest, and afterwards the protoplasmic substance broke up, and each spore gave rise to a *Bacillus subtilis* again. Their rate of multiplication was so excessively rapid that it needed only one of these Bacilli to get into a liquid, and in the course of a couple of days the whole of that liquid would be visibly turbid in consequence of the multiplicity of the Bacteria to an extent which no arithmetic could express. The importance of these bodies was that they exerted a fermentative influence, and they did for the fluid what yeast and barm did. It was this fermentative product which gave rise to putrefaction, and if they took such precautions as would keep out the bacteria, a dead body would remain intact for an indefinite period. It was on this principle that meats were preserved for an indefinite period by being partly boiled and then hermetically sealed in tins so as to preclude the air getting in. If they considered what would happen if all the animals that died remained where they died until they dried up, they would see what an important part these Bacteria played, and if they could all be gathered together they would make more than all the rest of the animal and vegetable kingdom. But they had a great significance which it was important they should all understand. In France there was an enormous silk industry, but it sometimes was almost annihilated through the death of the silk-worms, and that was almost always indisputably caused by a fungus. A disease which had all the characteristics of an infectious epidemic resulted in consequence of the germs of the fungi being introduced into the caterpillar, and each one infected became a source of infection, which spread in the same way as infectious diseases were propagated. There was a splenetic fever known in some countries which killed many cattle, and it had been made out that it was caused by these Bacteria. If they inoculated a healthy animal with it, they at once had the symptoms of the splenetic fever. A new disease had been investigated which was very fatal to pigs, which sometimes became epidemic, and which was caused by Bacillus. In vaccine lymph and smallpox there were small minute bodies, and it was found that in these the infection resided, so that they were coming to this conclusion, that the whole of our

great epidemics were of the same nature, and if that were correct there could be few forms of life of more importance than those in the limits of the visible, which he had been describing."

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

APPALACHIAN MOUNTAIN CLUB, June 11.—Mr. C. W. Folsom read a paper entitled Notes on elementary surveying for amateurs. Mr. J. B. Henck, Jr., exhibited and described several forms of pedometer, including the five dollar American pedometer.

July 9.—The seventh field meeting convened at the Crawford House, N. H. The meeting was called to order by Prof. William H. Niles, Cambridge, Mass., president of the club. A paper was read by Prof. Charles E. Fay, of Boston, on Mount Carrigan, to the summit of which a path had just been completed by the club. (Members of the club conducted a party from the Institute of Instruction to the summit of Mount Carrigan July 10th.) Prof. Hitchcock, of Dartmouth College, spoke on the geology of the White Mountain Notch. F. V. Hayden, U. S. geologist, spoke on the White and Rocky mountains, and Prof. F. W. Clark, of Cincinnati, on North Carolina and Tennessee mountains and scenery.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

AMERICAN JOURNAL OF SCIENCE AND ARTS.— July. Silurian formations in Central Virginia, by J. L. Campbell. Extinct volcanoes about Lake Mono and their relations to the glacial drift, by J. LeConte. (These volcanoes were active since and probably before the glacial period.) Recent additions to the marine fauna of the eastern coast of North America, by A. E. Verrill. Notice of a new Jurassic mammal, by O. C. Marsh. On the Hudson river age of the Taconic schists, by J. D. Dana.

PSYCHE. — July. Pupation of the Nymphalidæ, by W. H. Patton.

ZOOLOGISCHER ANZEIGER.—June 9. Keller on the embryology of the sponges (Chalina). Benecke on the maturation and fertilization of the eggs of the bats.

THE GEOLOGICAL MAGAZINE.—June, On recently discovered teeth of the musk ox (*Ovibos moschatus*) at Craybow, Kent, by W. Davies. The Glacial period in Eastern America, by C. H. Hitchcock. The Till in New England, by W. Upham.

CANADIAN NATURALIST.—June 23. A Canadian Pterygotus, by J. W. Dawson. Mœbius on *Eozoön canadense*, by J. W. Dawson.

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AN ACCOUNT OF A NEW GENUS OF MINUTE PAUROPOD MYRIAPODS.

BY JOHN A. RYDER.

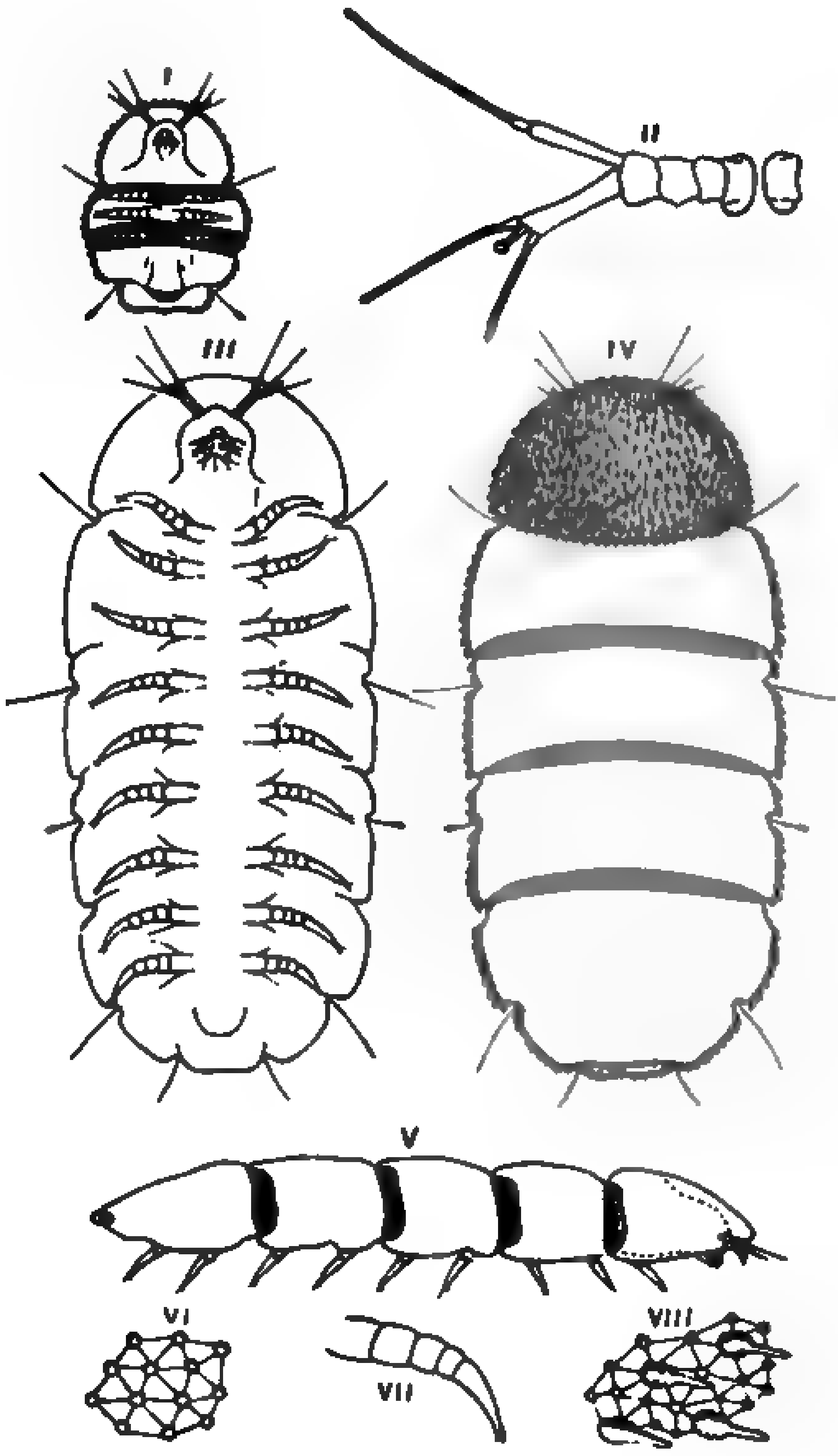
IN 1866 Sir John Lubbock first called attention to the remarkable little myriapod which he named *Pauropus* in reference to the fewness of its feet. He discovered the animal in considerable numbers under decaying leaves; he did not consider it exactly social in its habits; not noticing each other's presence, they did not exhibit the extreme ferocity toward each other which characterize some of the large carnivorous myriapods. In specimens of the same genus, however, which I found in Fairmount Park, Philadelphia, in the nests of *Termes flavipes*, upon two occasions, I noticed that when the point of a dissecting needle was carefully brought into contact with them so as to not injure their delicate little bodies, they would throw their heads around towards the offending needle point and "show fight" like the species of the carnivorous genus *Lithobius*. This was not noticed in the specimens of *Eurypauropus* which I am about to describe, and which I kept in confinement for about three months; in fact, the "bustling, active, neat and cleanly" little *Pauropus* is in strong contrast with the former in the two first particulars. The habitat of the new American form is much the same as that of *Pauropus*, being found in moist situations under sticks and decaying vegetable matter, and like it appearing to respire through the skin, so that if placed in a dry atmosphere it soon dies. None of the members of this group attain a large size, *P. huxleyi* being about $\frac{1}{20}$ of an inch long, which is about the size of the new form, whilst *P. pedunculatus* and *lubbockii* are both smaller.

Upon the occasion when Sir John Lubbock first exhibited his

then new species at the meeting of the Entomological Society of London, "Mr. Westwood remarked that, with the exception of the genus *Japyx*, described by Mr. Halliday, *Pauropus* was the most interesting addition to the Articulata which had been made for many years." This high degree of interest attaches to the discovery of *Pauropus* on account of the remarkable characters which it presents, and which constitutes it one of those types known to systematists as *synthetic* or *comprehensive*, that is, it embodies characters found in several forms widely removed from each other in the system. In the form of the body and legs the creature recalls the large carnivorous myriapods or centipedes, whilst in the possession of a pulvillus or pad, and a claw on the feet, they resemble in a measure true insects; in their branched antennæ they resemble crustaceans, and in their herbivorous habits they resemble the herbivorous, and in the distribution of the legs they combine characters of both the herbivorous and the carnivorous myriapods.

Sir John believes, after reviewing the opinions of the most distinguished naturalists, that the group must be considered a class having the same systematic value as that of similar subdivisions of the animal kingdom, and in view of the singular assemblage of characters presented by *Pauropus*, he thinks it necessary to erect a new order under the name of *Pauropoda* with a family *Pauropodidæ;* this arrangement would then cause the class to fall into three apparently natural groups.

To the three known species of the order *Pauropoda*, it gives us pleasure to add a fourth, so widely different from all others hitherto described as to leave no doubt as to the propriety of erecting a new genus for its reception. This singular form was discovered by myself in the month of April of the present year, in East Fairmount Park, in company with my friend, Mr. D. S. Holman. Upon that occasion five specimens were obtained, which formed the basis of the description of the genus published in the Proceedings of the Academy of Natural Sciences of Philadelphia shortly afterwards. Not long after, in an excursion with the same gentleman, I found five more specimens in West Fairmount Park, on the west side of the Schuylkill river, perhaps a mile from the first locality, which I succeeded, as stated before, in keeping alive until the middle of July last; having produced young whilst in confinement under such circumstances as to leave no doubt that



EURYPAUROPUS SPINOSUS, RYDER.

they were the parents and consequently that they were adults, having undergone no change meanwhile.

The new form, which in several respects differs in a remarkable degree from *Pauropus*, I have called *Eurypauropus* in reference to its great relative width. The antennæ are five-jointed as in *Pauropus*, but the proportions of the terminal many-jointed filaments are different. These filaments in minute structure are very similar to those of the old genus, being composed of saucer-like disks, which are superimposed in a linear series and united at their centers to each other by delicate but very short pedicels. These like the similar filamentous organs of *Pauropus*, I found could be studied very well with a power of 1000 diameters, as they measure little over $\frac{1}{300}$ of a millimeter in thickness or about $\frac{1}{7500}$ of an inch. The antennæ are inserted close together at the front of the head with a very narrow bridge of chitin intervening between them as shown in Fig. II. The outer branch bears two of the many-jointed filaments, between the bases of which arises a pedicel surmounted by a globular or ovoid semi-transparent body with linear sepaliform processes clasping it (but which are not shown in the figure), much as in *Pauropus pedunculatus*.

The body is composed, apparently, of six segments; there is a possibility that the head is composed of two, in which case there would be seven in all, but the most careful focusing failed to reveal more segments than the number stated above. The first or head segment is wide and broadly rounded at its anterior margin, and overhangs the head like a hood or shield with descending borders, from beneath which the ends of the antennæ project forward in a remarkable manner. The head is partly free, a large vacant space appearing on either side and in front of it between it and the free hood-like head shield or segment, the surface of which, as well as that of all the others, is covered with small tubercles and spines, as shown much enlarged in Figs. VI and VIII, whilst its margins, as well as that of all the others are fringed with hooks or spines directed backwards, as shown in Figs. I and IV. There are no other appendages belonging to the head segment except the first pair of legs, which seem a little shorter than those following. Between the first segment and the second there arises on each side a simple hair, which appears to be attached to the second segment, which is more than twice as wide as long,

and is overlapped in a peculiar way by the first, as seen in the diagrammatic side view of the animal in Fig. v, where the other segments are seen to overlap each other in succession in a similar manner. The third segment, of nearly similar proportions, has a notch in each lateral margin from which a simple hair arises as in the preceding segment. The fourth segment is very similar to the preceding in proportions, and is notched laterally in the same way, but from the notches on either side there arises a hair ending in a bulbous extremity. The fifth segment is somewhat like the first in form, but has a notch at either side from which there arises a simple hair, and it is truncate behind, the truncated part exceeding very slightly in width the diminutive sixth segment, which is nearly hidden beneath the fifth. On either side of the sixth segment, from a depression, there arises a short hair about half as long as the hair preceding.

I am led to surmise that the notches at the sides of the third, fourth and fifth segments of the adult possibly indicate that these were primitively compound, and in reality represent two segments fused together, which would make nine in all, counting the others as single; this view, though, evidently is not without objection, as there is quite as much ground for a belief that the others are equally as compound. From this point of view the structure of *Eurypauropus* becomes of the highest interest to the morphologist as representing the most extreme point in the reduction of the number of segments in myriapods. It is in fact *Pauropus* with the number of legs characteristic of that genus, but with a number of its segments obliterated by becoming apparently fused together and otherwise modified.

Two pairs of legs are attached to each of the second, third, fourth and fifth segments, which, with the single pair in the first segment, make nine in all. The legs are completely concealed from above, in life, by the lateral expansion of the body segments as in *Pauropus*, but the expansions are not composed simply of chitinous pleural pieces as in the latter, but the thin yielding whitish ventral body wall extends almost to the very margins of the segments. The joints of the legs are composed of thicker rings of chitin than in *Pauropus*, and the only portion of the creature where a thin chitinous body wall is apparent, as in the old genus, is about the head and belly. There is also no evidence of segmentation to be found here, the covering seeming to

be continuous from the head to the anal extremity, except at the points where the mouth and vent are situated. The mouth parts seem to be very similar to those of *Pauropus*, though in view of the fact that it has been very difficult to get a satisfactory view of the head portion of the animal, I will not be too explicit in my remarks on this head. The anal opening is guarded below and anteriorly by a semicircular plate of chitin, shown in Fig. III, on the under side of the posterior extremity of the fifth body segment. No evidence of tracheal openings has been observed. Eyes seem to be wanting, indeed the manner in which the first segment overhangs the head, would lead one to suppose that vision would be obstructed, rendering eyes useless; then the remarkable antennary structure may, in a great measure, replace the eyes; and it is difficult to understand the use of the pedunculate hyaline body unless it be auditory. May it not be that the Pauropoda as well as some Diplopods are blind? *Polyxenes*, I am convinced, is provided with very delicate tractile organs at the extremity of the antennæ, and Bode figures minute auditory organs on the head behind its glossy black eyes. It seems to me, therefore, probable, that the multi-articulate, terminal filaments of the antennæ of Pauropods are probably for the most part tactile, whilst the hyaline bodies are wholly or in part auditory in function.

The *larvæ*, of which I possess two specimens, yield no better evidence as to the composite nature of the head segment than the adults; the total number of visible segments in the young seems to be three with uncertain indications of a fourth. The evidence that these larvæ are the offspring of the adults which I had kept in captivity, is complete, having been taken from a chink in a bit of decayed wood into which the adults were repeatedly seen to crawl during the three months of their confinement. Moreover, the chitinous shells of the ova from which the young had escaped, were found in the same cranny. The larval *Eurypauropus*, Fig. I, is exceedingly depressed, more so relatively than the adult, and appearing on this account very much like a young *Cimex*, or bed-bug, and having much the same relative proportions, viz: $\frac{1}{63}$ of an inch long by $\frac{1}{83}$ of an inch wide, but altogether smaller. It presents the same peculiar features in the sculpture of the upper surface of its body segments as the adult, but the tubercles and spines are not as strongly developed, but the marginal serratures

are well marked. The thickness of the dorsal chitinous pieces of the segments is much less than in the adult, and hence the animal is much more transparent. From each side, and where the head segment joins the succeeding one, there arises a simple hair as in the adult, and from each side posteriorly at the points where the third and the fourth segments join there arises a clubbed hair. The legs are six in number, as is usual in larval myriapods, and appear to be confined entirely to the second segment, and have the same number of joints as those of the adults. The antennæ are of the same form and proportion as in the adult, and have similar terminal appendages. The mouth parts are likewise similar, and the wide free border of the head segment extends forwards and downwards anteriorly beyond the head, the same as in the full grown ones. The young, as would naturally be inferred, are very much paler in color than the old ones, and are of a pale reddish-white or lilac tint, whilst the adults are of an isabeline or pale rusty-red color, the closely set appressed spines on the back giving them a perceptible silky lustre when observed with reflected light; they are much paler below. Their color when viewed with transmitted light, is pale brown, due to the chitin of the body walls. It will be readily seen that the contrast in color between the new form and *Pauropus*, which is almost white, is very great, and sufficient to constitute, with its other features, a very important distinction.

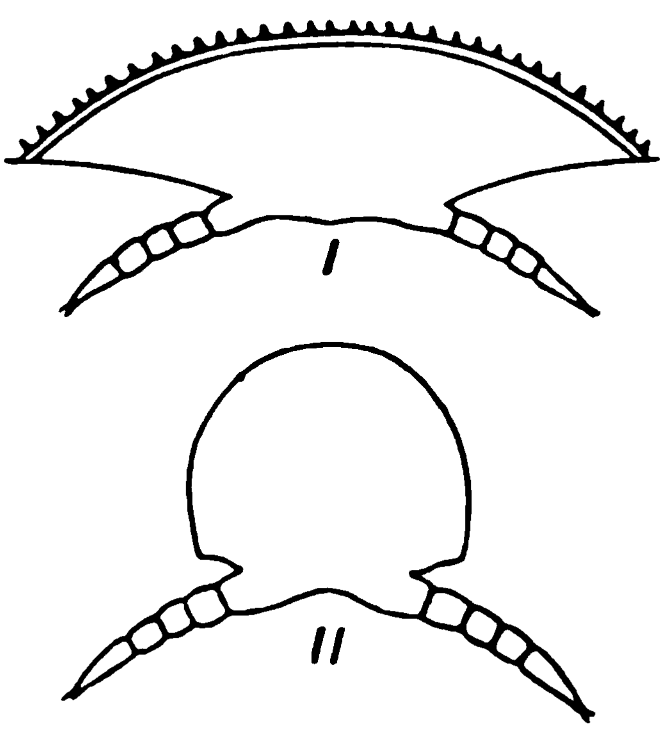
The internal anatomy of the new genus I have not yet been able to work out satisfactorily, owing mainly to the want of an abundance of material wherewith to prosecute the investigation, and also not less on account of the want of proper methods. These latter I think I will soon be able to apply. The entire bulk of the animal is perhaps three times that of *Pauropus*, and is therefore better adapted for anatomical study than the latter.

In habit *Eurypauropus* is much more sluggish than *Pauropus*, and does not scamper away into the nearest crevice like the latter when its haunts are exposed to the light. The specimens which I kept in confinement were placed in a wide-mouthed ounce vial, half filled with moist earth and corked up, into which I had placed some fragments of rotten wood, under which the animals could retreat; in this close place the animals lived for the time I have before stated. In physiognomy they much resemble diminutive sow-bugs, and they also resemble these in the choice

of habitat they make, but all of the specimens I have yet collected were taken from the under side of fallen limbs in damp, shady situations on the ground, not under the bark of trees.

Eurypauropus in some respects is a good deal like *Polyxenes*[1] in the shape and superficial ornamentation of its segments, but the dorsal serrate plumes and caudal fascicles of hooked bristles are deciduous in the latter, and may be readily brushed off, which is not the case with the tubercles and spines of the former.

In view of the fact that *Eurypauropus* differs from *Pauropus* in the same way that *Polydesmus* differs from *Julus*, in having the legs concealed by the lateral expansion of the body segments, as shown in the accompanying cut, where Fig. I represents a diagrammatic cross-section of *Eurypauropus* and Fig. II the same of *Pauropus*, as well as in having the head overhung by the anterior, lateral and downward production of the chitinous shield-like first segment, and that it has fewer segments than any other species of Myriapod, I venture to consider it a family under the name of *Eurypauropodidæ*. The following revision of the order becomes accordingly necessary.



PAUROPODA, Lubbock, Trans. Linn. Soc., XXVI, p. 181.

Body composed of 6–10 segments, convex or depressed, with scattered hairs or tubercles and spines. Antennæ five-jointed, bifid, bearing three long, jointed appendages. Nine pairs of legs; feet with a claw and pulvillus. Herbivorous.

I. PAUROPODIDÆ, Lubbock, l. c.

Segments ten, the chitinous annuli of which are circular

[1] Adverting to *Polyxenes*, I find that its eggs are usually more or less entangled in a felt composed of the caudal bristles, which is, no doubt, a protection against the ravages of the long-snouted mites, and I also find that the singular barbed hooks of these bristles in *P. fasciculatus* Say, are different in form from those of *P. lagurus* of Europe, according to the recent figures of Bode.

Prof. Leidy has recently informed me that he has lately found *P. fasciculatus* at Easton, Pa., which is the fourth locality known to me for this species, making its present distribution extend from Massachusetts to Georgia.

in section with very thin walls and without superficial sculpture. Head not concealed by the forward and lateral production of an anterior segment. Legs not concealed. White. With eyes.

1. *Pauropus huxleyi*, Lubbock, l. c.
Hyaline body of the outer ramus of the antennæ sessile. Length $\frac{1}{20}$ inch. Hab. England and E. Penna.

2. *P. lubbockii*, Packard, Proc. Bos. Soc. Nat. His., XIII, p. 409. Hyaline body pedunculate but shorter than in the next. Length, .03 inch. Hab. Salem (Packard) and Chelsea (Walker), Mass.

3. *P. pedunculatus*, Lubbock, l. c.
Hyaline body on a long peduncle. Length $\frac{1}{25}$ inch. Hab. England.

II. EURYPAUROPODIDÆ.

Segments six, composed dorsally of a thick plate of light-brown chitin, greatly depressed, three times as wide as high, spinose, tuberculate and reticulate on their upper surfaces; margins serrate. Head concealed by the hood-like anterior production of the first body segment. Legs hidden beneath the lateral expansions of the body segments. Reddish. Without eyes.

1. *Eurypauropus spinosus* Ryder, Proc. Acad. Nat. Sci. Phila., 1879, p. 139, and ibid. p. 164. Length $\frac{1}{20}$ inch. Hab. in Fairmount Park, E. Penna.

The discovery of additional species may now be awaited with some confidence, since the distribution of those already known has been so considerably extended by Dr. Packard and myself. Sharp eyes and patient search in quest of these and kindred minute forms will now reward the student with striking new and little known species much more quickly than by collecting the showy and conspicuous insect fauna of his neighborhood. It was probably the keen-sightedness developed by the experience of Sir John Lubbock in patiently collecting the *Thysanura* that led him to detect and scrutinize *Pauropus*, leading to its recognition as an important new type.

EXPLANATION OF THE PLATE.

FIG. I.—Larva of *Eurypauropus spinosus*, enlarged fifty times.
FIG. II.—Antenna of adult, enlarged two hundred and fifty times.
FIG. III.—Adult from below, enlarged fifty times.

FIG. IV.—Same from above, the sculpture represented only on the first segment, enlarged fifty times.

FIG. V.—Same from the side, enlarged forty-eight times.

FIG. VI.—Tubercles on the upper surface of the segments near their junction, enlarged two hundred and fifty times.

FIG. VII.—Leg, enlarged fifty times.

FIG. VIII.—Spines and tubercles of the back, enlarged two hundred and fifty times.

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MICROSCOPICAL FUNGI INFESTING OUR CEREALS.[1]

BY WM. BARBECK.

I. Ergot.—In examining a rye-field about harvest time we may be pretty sure to find some plants in which, although the ears with their bracts or glumes are apparently developed in a normal way, some of the grains have attained an abnormal size and are of a somewhat blackish color. We have here what is generally known as "Ergot" (botanically *Claviceps purpurea* Tul.), a fungus which is to be found almost exclusively on rye, and which, because of its poisonous effects on animal organisms, is dreaded, particularly in those parts of Northern Europe where rye bread forms the staple daily food.

This fungus shows three distinct stages of development, two of which were well known to former botanists, but were described as separate species belonging to entirely different genera. It is to Tulasne that we owe the discovery of their immediate connection and succession.

Towards June, when the sexual parts have been differentiated, we see a mucous, honey-like substance flowing from out of the bracts of the ear. In examining this "honey-dew" (as it is called by farmers) under a microscope of high power, we behold it swarming with millions of minute oval spores, or conidia, which upon further examination we find to issue from a delicate but complicated mycelium which penetrates the ovary, gradually transforming it into a soft whitish body of an oblong shape with shriveled surface. In this form our fungus was described and recorded by Leveillé as *Spacelia segetum.*

In the course of a few weeks the gelatinous membranes of the mycelium-threads harden and assume a brownish color. Thus the originally soft tissue is transformed into a body of a corky or

[1] Read before the Biological Section of the Academy of Natural Sciences, Philadelphia.

horny consistence. We now have the so-called "Ergot-grain," or the second stage of development of our fungus, formerly described as *Sclerotium clavus* Tode, and recognized as a good species among the Dermatomycetes. At the top of the "Ergot-grain" we behold the dried and shriveled remains of the *Spacelia* as a sort of hood of a dark-yellowish or brownish color.

In this form of *Sclerotium*, the "Ergot-grains," most of which, of course, fall out of the ears when the corn is taken from the field, remain on the ground unchanged through the winter.

In April of the next year the third and very interesting form, which by its discoverer, Tulasne, has been termed *Claviceps purpurea*, is developed. We behold a number of purplish carpophores, each ending in a yellowish head growing out of the *Sclerotium*. Each of these little heads shows in longitudinal sections a row of regularly shaped and arranged *peridia*. These peridia are filled with a number of *asci* containing the very minute and thread-like spores. Direct experiments made by Prof. Kuehn, of Halle, and other mycologists, have proved beyond doubt that when these spores are sown into healthy young blossoms of rye, they will in a short time produce the mycelium of *Sphacelia*. The same result is sure to be obtained by means of the conidia of the honey-dew, which in a comparatively short time will infect other perfectly healthy ears, and will even carry the disease over to other surrounding plants, such as several species of grass, etc.

Thus we have to regard the *Claviceps* spores as originating the disease in spring; the *Sphacelia* as propagating it during the period of fructification, and the *Sclerotium* as preserving the contagion through the winter.

It is generally known that the ergot when brought into the human organism operates as a narcotic poison. In certain years which were particularly favorable to its development, numerous cases of poisoning have been observed in Europe, and so we learn of a series of ergot epidemics recorded in official European statistics. In 1771, for instance, the disease was so acute in Westphalia and Hanover that in certain villages more than ninety per cent. of the cases proved fatal.

The parasite has acquired its German name "Mutterkorn," because of its contracting effects upon the uterus, owing to which it has become an efficient aid in obstetrics, well known under the old name of *Secale cornutum*.

The ergot in its *Sphacelia* form is, as mentioned before, not confined exclusively to rye, but its conidia infect several species of grass, such as Lolium, Bromus, Dactylis and others. Thus a number of diseases befalling our domestic animals are most probably to be ascribed to the "honey-dew" which the animals have eaten with such infected grasses. Of course the farmer ought to remove the infected plants growing in the neighborhood of his rye fields. He ought to pick out the ergot grains as much as possible before the corn is mown, and as they are only formed during the short period of fructification, he has to apply such methods of cultivating his ground (particularly the drilling) as tend to produce a simultaneous development of the fruits, thus reducing the dangerous period to a comparatively short time.

II. Smuts.—The Ustilagineæ, or smuts, are parasitic fungi whose fine-threaded, wide-spreading mycelium grows through large portions of the infected plants. They fructify, however, only in certain parts of these plants and at certain periods. In such proper places the threads of the mycelium increase rapidly, resorbing the surrounding tissue. Their free ends become divided into cells; the latter, after being separated, are surrounded by a second membrane and thus transformed into spores. These spores occupy as a brownish dust or powder the place of the destroyed tissue, and are set free in a measure as the infected parts decay.

The organs of the plant in which these fungi are fructifying, vary according to the species of smut. So we see the whole panicle of oat infected by *Ustilago carbo*, or "*oat-smut*;" the interior of the wheat grains by *Tilletia caries*, or "*bunt*;" the anthers of several *Sileneæ* by *Ustilago antherarum*, and the female cobs of our maize by *Ustilago maydis*, or *maize-smut.* When in any of these Ustilagineæ the spores are being formed, the threads of the mycelium become dissolved and disappear; consequently when the smut is fully developed we shall find nothing but the afore-mentioned spores.

Numerous experiments have shown that these spores maintain their power of germination for several years. When brought on a moist substratum they produce, within a few days, a germ tube or promycelium on which minute sporidia of various shapes, according to the various species of smut, are formed. According to the observations of Hoffmann, Kühn and other eminent

botanists, these sporidia penetrate the epidermis of young and tender corn-stalks, mostly in the region between the root and the first joint of the stem. The mycelium grows in an upward direction, following the course of the longitudinal cells. However, the growth of the plant seems not to be injured; on the contrary, the infected plants are apparently of a more fresh and bluish green, and it is not before the time of fructification that the devastation becomes visible.

The process of germinating is very nearly the same in the oat and maize smut, whereas the "bunt," or *Tilletia caries* shows some interesting peculiarities. In this parasite, which is to be found exclusively within wheat grains, the sporidia are produced in a verticillate manner from the germ tube. They repeatedly anastomose, and this anastomosis, or conjunction, is considered as an act of fructification, for immediately afterwards we see that oöspores are formed, from which very minute threads are sent forth which become free and carry the disease over to other wheat plants.

It requires an experienced eye to discover the bunt in any wheat field, for the infected ears are not distinguished in their outer appearance from the healthy ones. The diseased grains, however, when rubbed between the fingers, burst at the slightest pressure, and we see that instead of the white meal they are filled with a dark smutty mass, which is distinguished by a nauseous smell resembling herring brine, produced by a volatile oil, the trimethylamine, which is also to be found in herrings.

However destructive all these smuts may be, it is within the power of any farmer, if not to prevent at least to limit their excessive increase. The spores have been found adhering in large numbers to the grains which are harvested, and which, of course, when sown in spring, will transmit the contagion to the next crop. Now a solution of copper-vitriol, which is not hurtful to the seeds, is sure to kill the dangerous spores, and so we have an efficacious and at the same time cheap preventive remedy on hand.

III. Rusts and Brands.—The parasites of the hitherto described species we have found to be destructive to the several organs of fructification. The following fungi belong to an entirely different genus. They infest and destroy the stem as well as the leaves and vaginæ of our gramineæ and other cultivated plants, and

are generally known under the name of rusts and brands, or *Uredineæ.*

In examining our corn-fields in the beginning of summer we shall most likely find a number of plants covered all over with bright rusty, later in the year with dark brownish spots and lines. These pustules are produced by parasitic fungi which have their seat under the epidermis of the infected plants, and after being developed, burst through the epidermis in order to disseminate their spores. The very interesting development of these Uredineæ is a comparatively recent discovery, the more interesting as the originators of the disease are to be found on plants belonging to families entirely different from those in which the parasites are developed.

If in May or June we examine the leaves of some *Berberideæ, Rhamnaceæ* or *Asperifoliaceæ* growing in the neighborhood of our corn-fields (particularly those in damp localities), we may be pretty sure to find the under surface of such leaves covered all over with little cup- or jar-like bodies of a bright-rusty color. These little cups are what have long since been known as cluster-cups, or *Æcidium.* They present an elegant object under the microscope, and delicate sections will show that the interior of the cups is crowded with basidia, from which regular rows of bright-colored spores proceed. (These cluster-cups are generally attended by numbers of those strange little bodies known as spermogonia, growing mostly from out of the opposite side of the leaf, and sending forth thread-like spermatia, the real nature of which has as yet not been ascertained.)

Prof. de Bary, of Strasburg, has been the first to show that when these *Æcidium* spores are brought on certain species of corn, for instance those of *Berberis,* or Barberry, on rye, they immediately begin to germinate. The tender germ tubes force their way through the stomata and rapidly develop within the infected leaf a mycelium from which the afore-mentioned spores are produced on basidia beneath the epidermis. Prof. de Bary was led to the investigation by the pertinacious and often ridiculed assertion of old farmers, that the shrubs of Barberry were injurious to rye and oats; and indeed, his repeated direct experiments, as well as those of a number of other botanists, have proved beyond doubt that a very dangerous form of rust, the *Uredo linearis,* is produced only by the spores of Barberry cluster-cups.

In the same way it has been shown that other rust diseases, for instance, such as are produced by *Uredo rubigo vera*, which also destroys our cereal plants, are originated by certain cluster-cups growing on other plants in the neighborhood of corn-fields.

If we examine the rust-pustules more closely, either by opening them with a needle or by making thin sections, we shall find beneath the epidermis and growing on short peduncles, numerous yellowish spores. They represent simple oval cells, the protoplasm of which contains little drops of an orange-colored oil. The hyaline episporium is granulated and shows several translucent spots, the places from which the germ tubes will proceed. These germ tubes are rapidly developed, often within a few hours. They penetrate the stomata of other leaves and repeat the production, first of a mycelium, then of numerous spores, which again pierce with their germs through the epidermis of other plants. In this way the the process is continued through the course of summer, and it is easily explainable that under favorable circumstances the disease may be propagated from field to field, over vast tracts of land, assuming quite an epidemic character.

Towards the close of the hot season we see our fungi entering a new stage of their development. Repeated examinations of the rusty pustules will show that the latter are gradually transformed into bodies of a dark-brownish color. Let us examine these dark bodies a little closer. We shall find that from the former mycelium spores of a quite different shape and color have been produced. The Uredo or summer spores have disappeared and in their place we behold numerous dark-brownish two-celled spores with thick or perfectly smooth membranes growing on long pedicles. They are what is known as *brand* (*Puccinia*), and were formerly described as an autonomous species of fungi. In reality they are the winter or Teleuto spores of the rust. The spores remain with their peduncles attached to their stroma during the winter, and do not begin their germination before the following spring. Then one or several germ tubes are formed, which at their upper extremities become segmented into several cells. From each of these cells we see growing out a very fine thread, producing a sporidium. These sporidia are set free and are scattered by the wind, and when brought on the leaves of barberry are sure to produce the cluster-cups first described. (The latter fact has again been proved by numerous direct experiments.)

Thus we see the *Æcidium* producing *Uredo*, the *Uredo Puccinia*, and the *Puccinia* again *Æcidium*, and we have the interesting fact, that fungi of an apparently unlike structure, which have been hitherto described as belonging to different genera, and which are actually to be found on entirely different plants, are in reality but sucessive forms of development of the same parasite.

By this discovery of De Bary, the attention of a number of mycologists was directed to other species of rusts. Numerous experiments have been made, and thus the connection of a number of hitherto separated forms has been found out. We know, for instance, that one species of Uredo, *U. straminis*, which destroys the glumes and attacks the ovaries of wheat-ears, and which in 1862, in Denmark, caused a damage of nearly a million of dollars, has its *Æcidium* form on the several *Boragineæ*; that a disease on pear trees, destructive to the young leaves and ovaries, and known as *Ræstelia cancellata*, is the *Æcidium* form of a *Uredo* growing in early spring on *Juniperus* and hitherto described as *Gymnosporangium*.

In some rusts the winter spores present a form at the same time very elegant and quite different from *Puccinia*. So we see towards autumn the under surface of blackberry and rose leaves spotted all over with little blackish powdery tufts of the so-called blackberry brand or *Phragmidium*. These tufts are composed of four or five-celled elegantly granulated spores, produced on long hyaline peduncles. In the same places where we find them now we would have met a month ago the one-celled Uredo spores, and it is quite interesting to observe under a lens from day to day how (beginning at the circumference and moving towards the center) the dark winter spores are gradually superseding those of Uredo. This connection has also been discovered but recently.

In the same way the dimorphism of several other rusts and brands has been defined. However, we are as yet ignorant as to the development of a good many other species, and there is consequently a vast and at the same time highly interesting field left for further investigation.

IV. Mildew.—"Mildew," says M. C. Cooke in his Parasitic Fungi, "is one of those loose terms which represent no definite idea, or a different one to different individuals." It may be so in England; American farmers, however, as well as horticulturists of my acquaintance, unanimously apply the term to the several species

of *Erysiphe*, and so I understand under the name of "mildew" the mycelium of a parasitic fungus which, sometimes very thin and cobweb-like, sometimes in a thick, felty layer, disturbs the development of the infected plant, particularly by obstructing the stomata, perhaps also by drawing its nourishment from out of the infected organs by means of little wart-like processes, through which the mycelium is attached to the plant on which it feeds.

Among the great many varieties of *Erysiphe*, which are to be found on the leaves of different trees as well as on a great many ornamental and useful plants, we have to deal here with one species, *E. graminis*, which in certain years is to be found in abundance, covering the leaves of the several cereals.

The real nature of this parasite has likewise but recently been discovered, and it requires a good microscope to discern the minute organs of fructification.

Soon after the formation of the "mildew" has commenced, we see some of the mycelium-threads growing upwards in a vertical direction. These threads become segmented into several cells; each of these oval cells is separated in the same way as we have seen in Sphacelia, is transformed into a conidium, and by means of these conidia, the mycelium is propagated during the summer months, with incredible rapidity under favorable conditions.

Towards the close of the period of the growth of vegetation we see in a very interesting way that peridia are formed by means of a sexual process.

At the crossing point of two mycelium-threads two cells of a somewhat unlike shape are differentiated. The larger one, issuing from the inferior hypha, is club-shaped. It is (according to De Bary, to whom we are indebted for very careful investigations of this subject) the female "ascogonium," as he terms it, against which the much thinner "pollinarium" (growing up from the inferior hypha) leans closely. The contents of the pollinarium being absorbed by the female organ, the latter begins to swell or enlarge as the pollinarium disappears. In the mean time a number of secondary threads are developed at the basis of the ascogonium. These threads surround and enclose the ascogonium, producing numerous lateral as well as inward growing ramifications. The lateral threads weave themselves into a compact tissue which afterwards hardens, becomes brownish and forms the outer coat of a peridium, while the space between this coat and

the ascogonium is filled up by the loose tissue of the inner ramifications.

The ascogonium is divided by repeated partition into a number of asci, each of which in our species contains eight spores. According to the observations of several botanists, these spores are not developed before the next spring, so that the parasite is preserved through the winter by means of the peridia. In most species of *Erysiphe* these peridia are provided with hyaline appendages, some of which are of wonderful regularity and elegance of form, when seen under the microscope.

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FRESH-WATER ENTOMOSTRACA.

BY C. L. HERRICK.

THE collector of fresh-water specimens is constantly meeting unexpected forms, especially among the smaller organisms, and of these no order of animals furnishes a wider variety or more curious adaptations than the fresh-water Crustaceans embraced in the old group *Entomostraca*, which is by many authors at the present day subdivided into several orders of Crustacea, the name being retained for a single order. To the microscopist particularly they are available as a never-failing field for study, since a cup of water from almost any source will contain abundant material for a day's work.

The Entomostraca have specialized jaws, but the gnathites never exceed three pairs. The segments of the abdomen are devoid of appendages. The name was derived from two words, meaning insect and shell, by Otho F. Müller, and applied by him in his "Entomostraca" (1785) to the animals which had hitherto been all comprised in Linnæus' genus *Monoculus*, named from the supposition that they possess but one eye. This order has, generally speaking, been much neglected, and in America particularly it seems to have escaped attention. The members of this order are never large, and many are so small as to be with the greatest difficulty detected by the unassisted eye, yet from their great variety, wide range and immense number they assume a position of considerable importance in the animal kingdom.

Recent investigations instituted by Mr. S. A. Forbes, of the Illinois State Laboratory of Natural History, have emphasized the fact that the lowly animals play important parts in the economy of nature, he having found that these Crustaceans enter

largely into the diet of fish, even of the larger varieties. The larger portion of the Entomostraca, numerically at least, are vegetable feeders and live on the minute particles of matter floating in the water, which otherwise would tend to render our waters impure. The snails wipe clean the stones and water-plants, and the scavenger fishes remove the carrion, but it remains for minuter forms to search carefully each drop and remove the particles, microscopic even to the thousand eyes of the dragon-fly larva. Thus the *Sida* (Plate III) in swimming uses the branchial feet within the shell-valves, not only in taking the necessary air from the water, but, by creating a counter current between the bases of the feet, particles of food are constantly brought within reach of the jaws. In common with low forms of animals in general, the processes of reproduction are often curiously anomalous. Congress of the sexes is in many cases unnecessary for many generations, and some forms, especially the *Artemia*, or "brine shrimp," seem unusually susceptible to changes in their environment. Males are often produced only in certain seasons of the year or under certain climatic conditions.

In the *Daphnia* the females produce young by simple budding from the ovary, but in the winter the ovum is enclosed between the valves of the carapace, which is removed at each molt, and it is thus enabled to resist the severity of the cold season. Speaking of the molt it is interesting to note that every hair, even to the finest filament, throws off a sheath, so that the cast-off integument is a perfect copy of the animal from which it came. In the higher forms the eggs are carried during the later stages of embryonic existence in double or single sacs extending beneath or on either side of the abdomen. In the *Daphnia* and other forms enclosed in a carapace the animal is oviparous, and the young can be seen within the shell in a cavity above the abdomen for some time before they are sent out to paddle their own crystal canoe. They may be removed from the parent without inconvenience. In the larger sub-division, the *Lophyropoda*, the chief organs of locomotion are one or both pairs of antennæ, though natatorial feet are never wanting. The antennæ also serve as prehensile organs in the *Cyclopoidea*, while the feet throughout the whole legion have branchial filaments.

Every one who has used the microscope has met with some of these animals, and we will mention a few forms. If water, taken from the clear surface of a lake on a sunny day, be carefully ob-

served, often a delicate, transparent animal may be seen darting about in the vessel like a flash of light, or if the lake be shallow and abounds in water plants the related form represented in Plate I may be seen. As it springs from side to side of the jar it seems a living jewel, for the antennæ and abdomen are tipped with varying purple, and the body glows yellow and scarlet, and if the bright-red egg-mass be present it is a conspicuous object. Place it under the microscope with a low power and we can see the long flexible antennæ, and if it is a male the thickened basal joints can be seen terminating in a spine at the thirteenth, where the geniculating joint is situated. The antennules on either side of the head segment, which is distinct from the thorax in this species, and the stylets on the last joint of the abdomen, with their setæ, are noted—when the antennules begin to rotate like the paddles of a steamer, and bending the abdomen and immediately launching a powerful "kick" with the caudal setæ spread out, at the same time that the antennæ beat the water like oars in the hands of an expert, the animal springs out of sight. One instinctively looks for the fellow some yards away, but remembering that the whole animal is little over .06 of an inch long, we again adjust the slide and bring him into view.

More abundant than the *Diaptomus* and better known, is the *Cyclops*. Plate II represents a large species in which the hairs are greatly elongated, especially on the caudal setæ, the longest pair of which resemble feather dusters. The Cyclops has received more than its share of names, owing to the great difference between different stages of its existence. If we place a female Cyclops in a vial, in a few days little specks will be seen swimming about in the water, and the eggs will have disappeared. These specks prove to be the young of Cyclops, but so little like the parent that it requires much faith to believe they will ever assume its likeness. Instead of five pairs of feet there are but three, and as we watch the growth of the animal, these prove to be elementary antennæ and jaws, while the true feet bud out of segments not yet formed. Almost every pool furnishes another example of the *Cyclopoidea* in the *Canthocamptus* which resembles the *Cyclops* greatly, and goes through the same transformations. The body tapers gradually with no marked distinction between thorax and abdomen; the egg-sac too is under the abdomen, and has in connection with it a colorless tube.

Perhaps the next animal to attract our attention will be a crea-

ture clothed in defensive armor of crystal, with an ovoid helmet on the head, from beneath which protrude the secondary antennæ, which in this family are always the larger, and the chief organs of locomotion. On the back is a small shield-like plate from which are suspended the two plates enclosing the body. Under the scuta of the back the heart can be seen pulsating regularly, while just below it is the intestinal canal, usually green from the vegetable matter contained therein. The jaws are suspended from the upper part of the head and meet below, where their toothed, grinding edges are placed in opposition, so that all the food must necessarily pass between them to be comminuted. The existence of a median dorsal plate in Daphnia seems to have been overlooked, it will be readily found however in this species (*D. vetula*) by placing a specimen on a slide and allowing it to dry and then tilting it up.

The genus Daphnia is quite well represented in our waters, both in variety of species and abundance of specimens. The section of the genus separated by Dana and called *Ceriodaphnia* includes those members which have a cellularly reticulated shell, but this character does not seem constant in the closely allied smaller forms which it evidently ought to include, if indeed the same species may not embrace forms with both reticulate and non-reticulate shells.

One of the most interesting of all Daphnia-like species is *Sida*, Plate III. A species of *Sida* and also a new species of the allied genus *Daphnella* occurs in Minnesota waters. The body of Sida is highly transparent, rendering the study of the inner parts less difficult than in most of these animals. The movement of blood corpuscles in the head and the currents caused by the branchial feet (indicated by arrows in the drawing) can be readily traced.

The curious *Polyphemus* also is represented, an animal in which the body is much curved upon itself, and the last joint of the abdomen is greatly elongated and bears two long flagella. The single staring eye, occupying the whole of the head, is the most conspicuous organ, while the apparently undeveloped branchial feet at first suggest the young of some other species.

But the most curious of all these minute, shelled forms, is the single species of *Bosmina* (Plate IV), which constitutes the family Bosminidæ of Dana. The idea at once suggested is a strange burlesque on the elephant, though the animal is not by any means of elephantine proportions, being not two hundredths of an inch

in length. The superior antennæ, usually very small or nearly obsolete in the Daphnoidæ, are the longer, but they agree with those of other members of the tribe in having little motion or play. These many-jointed appendages constitute the trunk of our elephant, lying as they do in so close juxtaposition as to seem a single organ. The shell of Brosmina is tuberculate and partly, at least, reticulated with hexagonal cells.

A group of smaller animals than any of the above is the old family *Lynceidæ* which is now included in the Daphnidæ. Many genera have been formed, but only one or two are founded on reliable generic characters. *Eurycercus* contains an animal nearly as large as Daphnia, but the remaining animals are small and they all agree in moving by a steady progressive motion rather than by successive bounds, which peculiarity is due to the shortness of the antennæ. The head is sharper in front and a little black spot beneath the eye, which is common to all Daphnidæ becomes in *Lynceus* and its allies as conspicuous as the eye itself. This spot is of unknown use but seems connected with the base of the antennæ.

There are representatives of two genera of the family *Cypridæ* to be found in every pool. These animals are enclosed in a shell which covers not only the body but the head also, so that the animal can withdraw entirely from view and close his shell about him like the mussel, which the shell much resembles in shape. The *Cypris* scurries about with an uncertain running motion, reminding one of the haste of an excited man, while the *Candona* loves the bottom. The inability to swim freely is due in Candona to the absence of the many setæ on the antennæ (the principal motary organs), which broaden these paddles in Cypris. In this sketch only a very few forms have been glanced at, and the legion *Phyllopoda* containing *Branchipus* and the "brine shrimp," has not been noticed, but objects enough to employ many a leisure day have been seen, any one of which might well repay weeks of study.

DESCRIPTION OF PLATES.[1]

PLATE I.—*Diaptomus longicornis* Herrick, back view of female and side view of male; *a*, basal portion of male antennæ showing enlarged segments preceding geniculating joint.

PLATE II.—*Cyclops* sp. ? *a*, last pair of feet; 1, 2, 3, 4, 5, feet of *Cyclops quadricornis;* 6, inferior antennæ.

PLATE III.—*Sida crystallina* Straus. *a*, *b*, *c*, feet of first, second and last pairs; *d*, jaw: *e*, extremity of abdomen; *f*, superior antennæ.

PLATE IV.—1, *Bosmina longirostris;* *a*, portion of shell with superior antennæ; *b*, anterior antenna; 2, *Lynceus* sp. ?

[1] Used through the kindness of Prof. N. H. Winchell, Director of Minnesota Geological Survey.

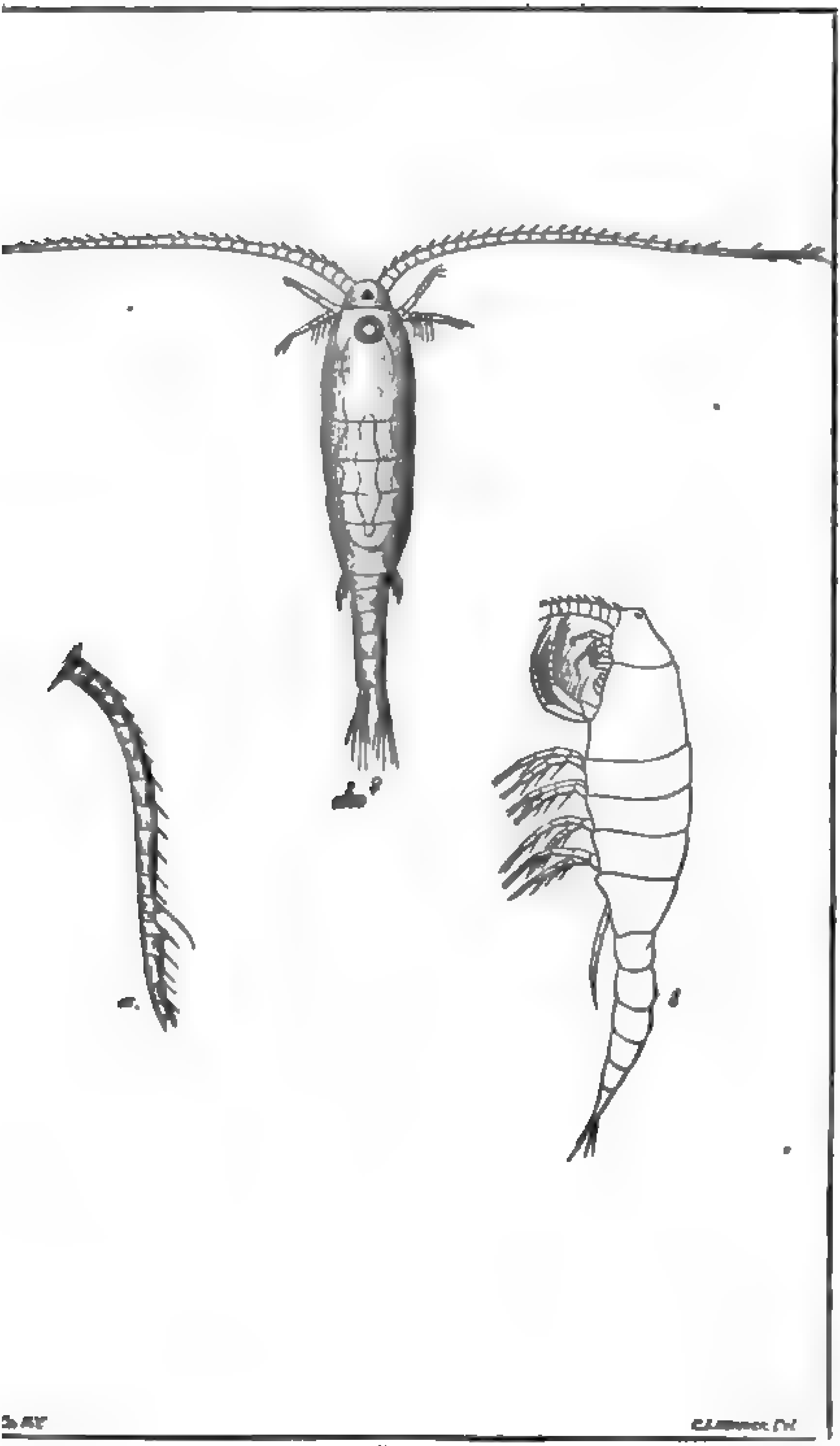

PLATE I.

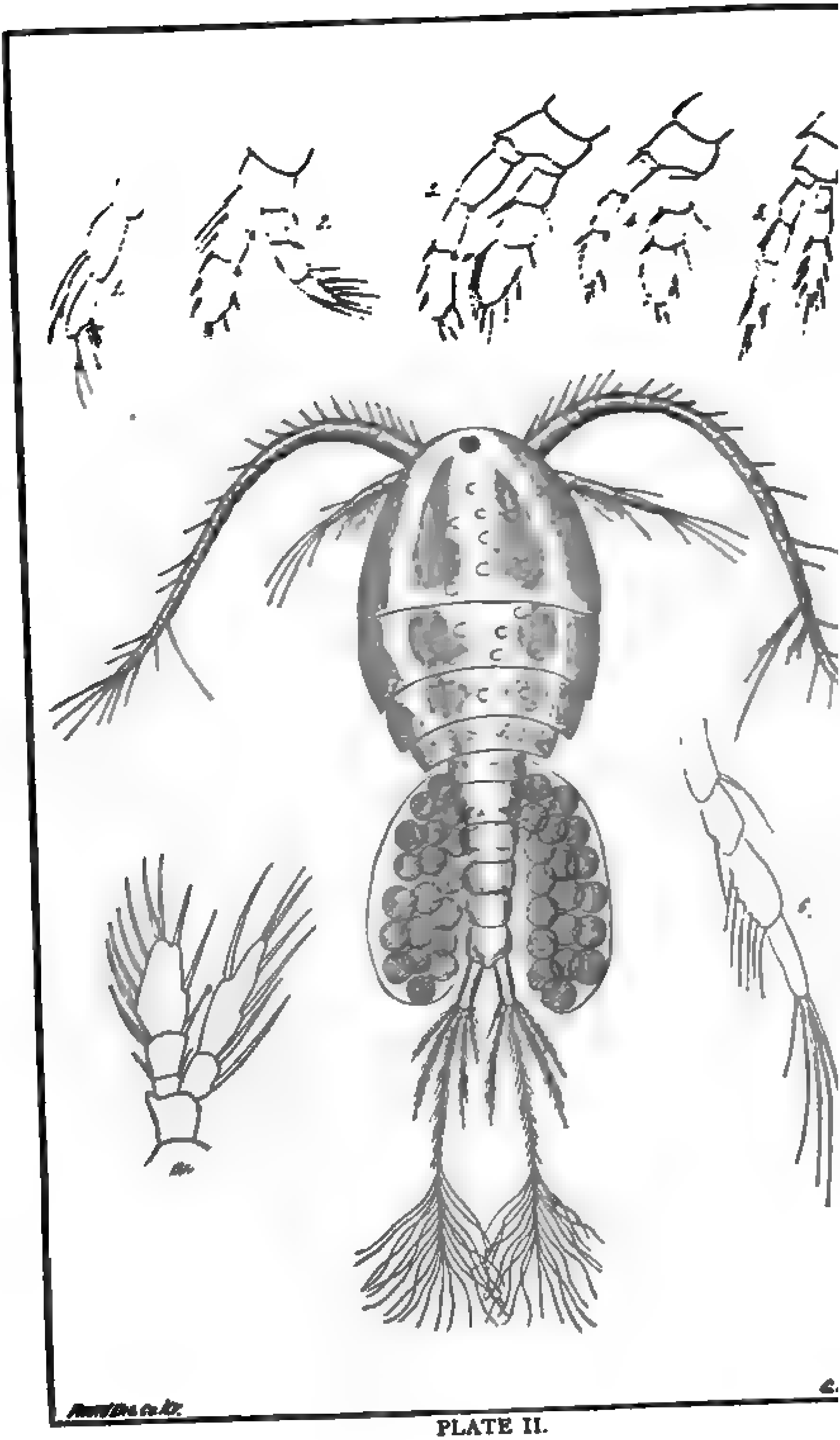

PLATE II.

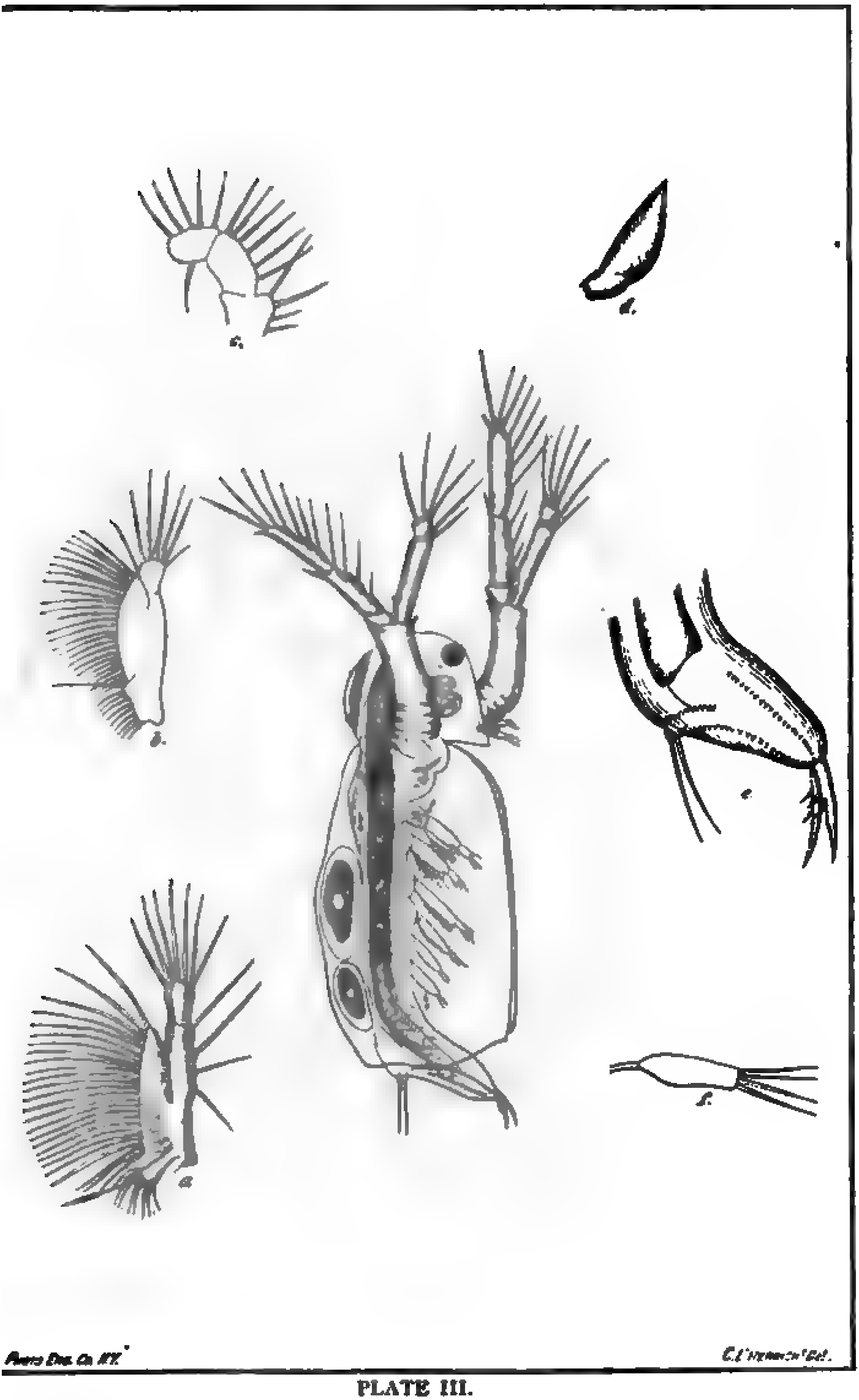

PLATE III.

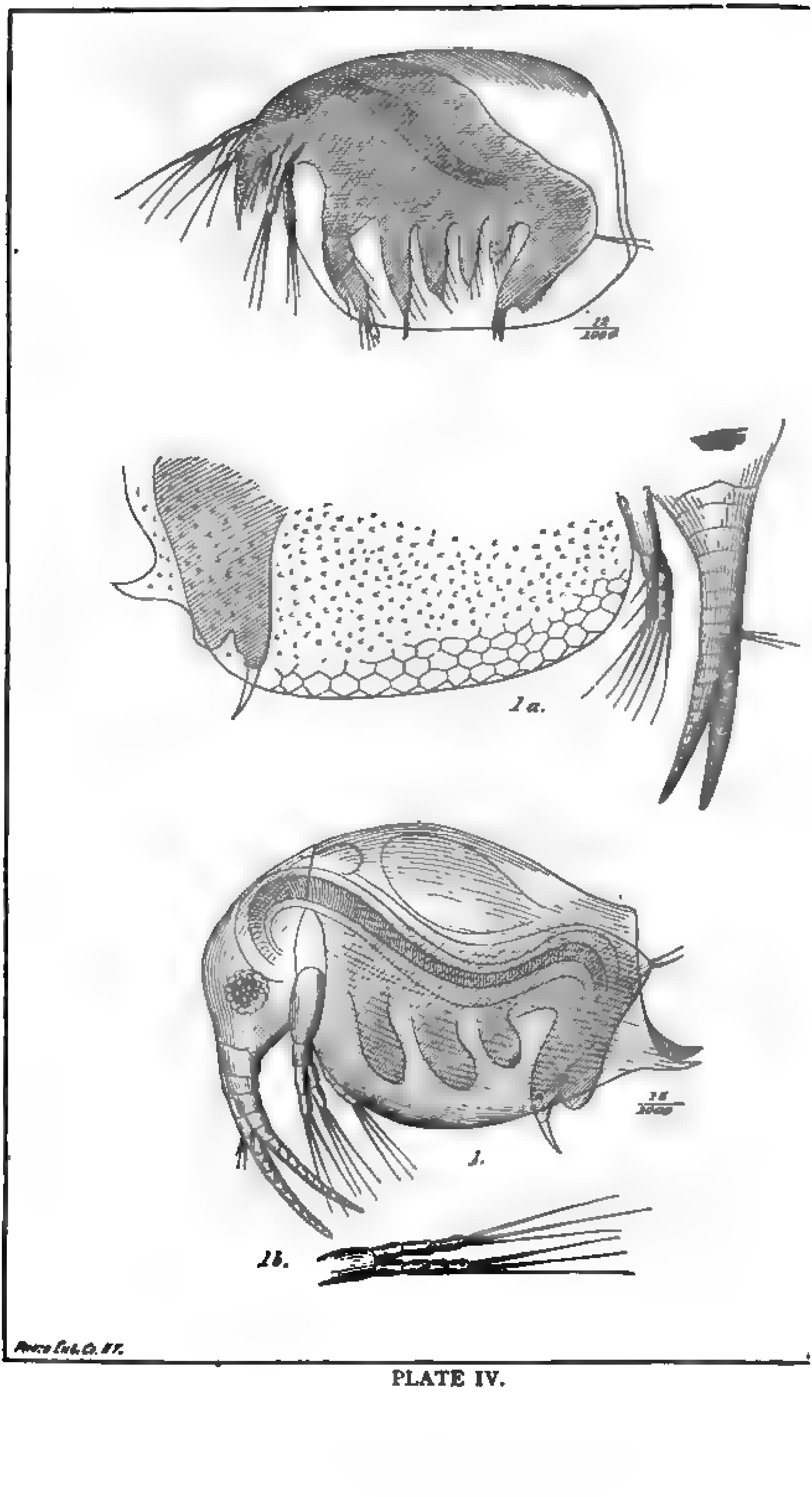

PLATE IV.

NOTES ON THE THRUSHES OF WASHINGTON TERRITORY.

BY S. K. LUM.

ALTHOUGH the number of species and varieties of the Turdidæ of the north-west coast is few, yet the number of individuals is great. The genus Turdus is here well represented by four species and varieties, viz: *T. migratorius*, *T. nævius*, *T. pallasi* var. *nanus* and *T. swainsoni* var. *ustulatus*. These, with Townsend's flycatching thrush (*Myiadestes townsendi*), comprise the list that I have observed in Western Washington Territory during a residence of twenty-five years, never having met with even a straggler of the genera Mimus or Harporhynchus. I am aware that the cat-bird (*M. carolinensis*) has been accredited a place in our avifauna (See Coues' Key to N. A. Birds, and Birds of the Colorado valley). Cooper speaks of it as found in the Cœur d'Alene mountains, and others as observed in Eastern Washington.

I have traveled extensively in Eastern Oregon and Washington without having met with a single specimen of this bird. There is a bird here, the towhee bunting (*Pipilo erythrophthalmus* var. *oregonus*) that utters a cry similar to that of the cat-bird, and, from the sound, might easily be mistaken for the latter bird. If found in Western Washington at all, it is as the veriest straggler, or I should certainly ere this have recognized my old acquaintance.

Townsend's flycatching thrush arrives here in March and remains until June. Their general appearance and habits are more those of a flycatcher than of a thrush. They may be seen perched upon the dry limb of a tree like the flycatchers, watching for insects, making sallies out after them and then returning to the perch.

During these times they now and then utter a loud, clear note, resembling the word "brevier," the accent on the last syllable. I have never heard the song spoken of by others, and so far as I know, they do not breed in this section. I have seen the young birds in their spotted plumage in the Sierra Nevada mountains of California.

The robin is extremely abundant, a few remaining during the winter, the majority passing further south; they breed here in great numbers, the nest being not unlike that of their eastern relatives.

The varied thrush will bear a more extended notice. Like his near relative, the robin, he is migratory, having a more northerly range. In numbers they nearly equal the robin. By the first of May they have all left for their northern homes to engage, as we are told, in the great work of reproduction—the shores of Alaska and the valley of the Yukon river furnishing them all that is necessary. About the first of October, when the first frosts have crimsoned the leaves of the vine maple, and the detached leaves of the large maple are slowly settling with their zig-zag motion to the earth, the ground already covered by the yellow forms, then may be heard the exquisitely sweet and musical notes of the varied thrush—not in a variety and succession of notes, but in one prolonged strain of a few seconds in a minor key; this is repeated at short intervals. Frequently there are several birds in company, varying in the pitch, thus giving a concert of voices succeeding each other, so tender, so plaintive, that the rude woodsman pauses to listen to the charming melody and asks, what bird is that?

The song of this bird, spoken of by Drs. Cooper and Suckley, I have never heard. This may be accounted for by the fact that I have never known them to remain here during the summer, which is their breeding time, and at other times than this they seldom utter these notes or I should have have observed it. They spend most of their time on the ground scratching for insects, and when flushed alight on the lower limbs, uttering a sharp "chuck!" "chuck!" then ascending higher and higher until out of danger. They are more vigilant than the robin and more disposed to scratch and turn over leaves after the manner of the "chewink."

Last winter I caught one alive and placed it in a cage; in a few hours it became reconciled to me, and took food from my hands. It would cram itself with rotten apples and bits of fresh meat until it could hold no more, and then look at me as much as to say, "I am sorry I can accept your generosity no more." In the course of a few days I secured another, which I placed in the cage with the first.

I soon discovered that the first one, so far from being pleased with his company, was quite the reverse, for the second being the older and stronger bird, pounced upon him in the most determined manner to kill him. I separated them, but no sooner was

my back turned than he renewed the attack, and would have killed him in a short time. I then removed the second one and introduced him in a cage with a sly, thieving, quarrelsome Steller's jay (*Cyanurus stellerii*). Now let the oppressor be oppressed; we will see the result. Thrush number two recognized an old acquaintance, and with that deference which consciousness of another's superiority inspires, quietly laid aside all hostilities; the two lived together peaceably, so far as I could discover, the jay being the more magnanimous of the two.

Three of our thrushes are found here during the entire winter, in greater or less numbers, viz: the two already treated of and a third, the dwarf or hermit thrush (*T. pallasi* var. *nanus*). Although most of the latter thrush pass further south, a few remain all winter. I have myself observed them in considerable numbers in the coast region north of San Francisco, Cal., in January. Their habits are shy and retiring, being found oftenest on the ground among the thick bushes.

In March and April they pass here on their way to their breeding grounds further north. I have never seen a solitary bird here during the summer. About the last of September they make their appearance from the north. Judging from the accounts of authors, of the powers of song of the near allied eastern hermit, we would suppose *T. nanus* to be possessed of musical powers of a high order. Perhaps this might be so could we observe him in his chosen breeding grounds accompanied by his mate and tender nestlings. However this may be, with us he is entirely silent, so far as I can say. If his presence is detected it must be from sight alone.

But if *nævius* and *nanus* withhold from us their song and desert us for more congenial northern homes, their place is well filled by another member of the family (*T. swainsoni* var. *ustulatus*). About the first of May, when the thick tangled, deciduous undergrowth of the tall sombre fir forests is decked in green, their blossoms on every hand exhaling perfume, will be heard the signal note of this bird announcing his presence among us. The lover of bird music now knows that the time for his enjoyment is at hand. The first note, loud and clear, is only a foretaste of what is to follow. The male has arrived first and is taking a survey of his old familiar haunts to see that all is right and the way clear before his mate joins him. For several days after his arri-

val no song is heard, then a low succession of notes comes from the thicket copse, as if he were trying his organs and training them for the grand concert to come. As time passes, these notes increase in strength, and by the first of June, when his mate has joined him and the site for their summer's nest is chosen, he seems enraptured by his own powers, as with quivering wings he pours forth a volume of song that seems to vibrate the green leaves of his surroundings.

You may hear him, but will seldom see him, so shy is he. Once, when this thrush was so absorbed in his own performance that he scarce seemed to notice me, I succeeded in getting directly under him. He sat on a limb about ten feet above me; first stretching himself up, he would utter a loud note similar to the last syllable of the bob-white quail, the "white" ending with the rising inflection; this was the prelude; then would follow a succession of notes impossible to describe, and which I can only compare to the vibrations of a wire or bell when struck, the undulations of sound gradually decreasing in volume and rapidity to the end. It seemed coming from a direction I could not determine, and as if broken in a thousand fragments on the surrounding shrubbery.

During the month of June the nest is constructed. It is oftenest found in low grounds, where the water stands during the winter, but at this season is dried up. Sometimes it is placed on the horizontal branch of a fallen tree, at other times in a small bush, and generally from three to six feet from the ground. It is simple in construction, being composed almost entirely of moss, about three inches in its inner diameter by two inches in depth. The eggs, four or five in number, are $\frac{15}{16}$ of an inch in length by $\frac{11}{16}$ of an inch in breadth, with a pale blue ground spotted all over with light reddish-brown. This I suppose to be the main breeding grounds of this thrush; their nests are found everywhere in the thickets of the lowlands, while during the early morning and the evening, from the dense forest and the thickest copse, and every sequestered grove, come the strains of this prince of the birds of song; who, as if loth to desist, often prolongs his song until after sunset, when the shades of night have thrown a weird gloom over the depths of the forest.

THE LEATHER TURTLE.

BY JOHN FORD.

IN all the realm of nature few avenues are more attractive to the student than those which lead into the ocean, for though trodden from time immemorial, a peculiar glamor still haunts the almost impenetrable veil beyond which they end. Such a mysterious charm might of itself awaken an interest in the minds of men. But an incentive far more potent is found in the hope that behind this shadowy veil thousands of unknown forms of life are hidden, awaiting only the coming of some modern Aladdin at whose touch the doors of their habitations shall fly open and their strange and weird beauty be revealed.

That myriads of living creatures do people these wondrous depths is shown by the appearance, at intervals, of the more venturesome ones on our shores, inciting the careful observer to renewed efforts in the study of their forms, their habits, and their previous surroundings.

It is true that many problems regarding the latter must of necessity remain unsolved, yet much may be studied and much be learned by patient and persistent endeavor.

With this purpose in view I have collected a few facts respecting the recent advent of specimens of *Sphargis coriacea*, a species as little known to the general reader, perhaps, as any other of like dimensions found in the Atlantic. The animal has indeed been referred to by a number of writers, but in all probability their stock of information has, in most cases, been derived from hearsay rather than from direct examination of specimens. In an English work on general zoölogy, published by Dr. George Shaw in 1802, we are informed that the coriaceous tortoise is a native of the Mediterranean, albeit specimens had been taken now and then on the coast of England; and of one captured in 1729 near the river Loire, in France, the author remarks: "It is said to have uttered a hideous noise when taken; its mouth at the same time foaming with rage and exhaling a noisome vapor." He also adds, that according to Lacepede, "the Coriaceus tortoise is one of those with which the Greeks were well acquainted, and he supposes it to have been the species particularly used in the construction of the ancient lyre or harp, which was at first

composed by attaching strings to the shell of some marine tortoise."

The first specimen seen in this latitude, of which I can find any record, was captured in Chesapeake bay in the year 1840. This was measured by Dr. E. Hallowell, an eminent herpetologist, but his figures differ so slightly from others made more recently, it is unnecessary to repeat them. As, however, the description given in the second volume of North American Herpetology, a work published in 1842 by Dr. John Edwards Holbrook, was the result of an examination of this specimen, it is reproduced here in a somewhat condensed form, as follows:

"*Characters.*—Head large, jaws strong, superior having three deep triangular notches, inferior hooked; body covered with a coriaceous skin, tuberculated in the young, smooth in adult animals; extremities without nails.

"*Description.*—The carapace is sub-cordiform, largest before and deeply concave on the neck; it is narrow and pointed behind and above, and is marked with seven longitudinal carinæ, one of which runs along the entire vertebral line. On either side of this are three others, the external ones following the margin of the carapace from its anterior to its posterior extremity, where they meet in a point above the tail. The nostrils are anterior and near together. The neck is short, very thick and covered with a coriaceous skin. The anterior extremities are twice the length of the posterior ones. The tail is short and extends but little beyond the carapace. The whole superior surface of the animal is of a dark brown color with exception of the carinæ, which are tinged in different places with obscure dirty white."

A very fair portrait of *Sphargis coriacea* accompanies this description.

So far as I can learn no later evidence has been given of the presence of Sphargis on our shores prior to the summer of 1878, when four specimens were stranded upon the coast of New Jersey. Of these two were doubtless first discovered near Atlantic City by the writer and a friend, Mr. Chas. Morris, one of them, in fact, being observed for some time before it was borne by the waves to our feet. They were both dead, though otherwise in good condition.

The two others mentioned were landed at a later period near Beach Haven, Ocean county. In reference to them Isaac Hall, an old sea captain, remarked, that "he had seen turtles of all

kinds, but these were the largest he had met in any quarter of the globe."[1]

In the early part of the present year (1879) a fine specimen was shot off the coast near Wilmington, North Carolina, by Capt. Chadwick of that city; and still later another was caught at Gloucester, Virginia, by Mr. W. H. Ash, the wharf agent at the point, who struck it a powerful blow on the head with an oar, stunning it and making it an easy prey.

The former of these, which is said to have measured seven feet in length by three and a half feet in width, appears to have puzzled the good people thereabouts in regard to its true character, some calling it a turtle and others a devil-fish, while the captain held to the opinion that it was Old Nick himself. Unfortunately, however, for their future prospects, it proved to belong to the species under consideration; "more's the pity," perhaps.

The specimen taken at Gloucester Point, though smaller than the last mentioned, was none the less surprising to its captor and others who saw it, many of them being of the same opinion regarding the fate of "Old Nick" as their more southern brother.

With the exception of one taken alive in Delaware bay, June 1, 1879, the above half dozen specimens comprise, so far as any records appear, the whole number found on our coast since 1840, a fact which seems to corroborate the opinion of Dr. Holbrook, who assumed that they were quite rare in American waters. Nevertheless, Dr. Leidy, Mr. John A. Ryder and others, who have given the subject much attention, believe them to be more plentiful than has been supposed.[2]

As a proof at least of their wide distribution, it may be mentioned that in addition to those referred to by Dr. Gray, two specimens were cast up on the coast of France in 1872; one of

[1] An account of this turtle was given by Dr. D. H. Storer in his Report on the Reptiles of Massachusetts, 1839. The specimen there described was figured on an excellent plate by Dr. Jeffreys Wyman; it "was taken asleep on the surface of the water in Massachusetts bay, in the year 1824." A specimen weighing about 1000 lbs. was captured in Narragansett bay in the summer of 1878, and was presented to the Museum of the Brown University. Providence, R. I., where it was stuffed by the Curator, Prof. J. W. P. Jenks.—*Editor.*

[2] Since the above was written I have learned from Mr. John H. Dusenbury, a Philadelphia dealer, that he received a dead specimen of *Sphargis coriacea* from Delaware bay, in 1872, which weighed 916 pounds; the skeleton of which was afterwards placed in the collection belonging to Mr. O'Brien, the showman.

which was obtained by Prof. Paul Gervais, and the skeleton preserved by him for the Museum d'Histoire Naturelle at Paris.

The great age of the genus in Europe is also shown by the discovery of *Sphargis pseudostracion* Gervais, in the Miocene, near Montpelier. *Protostega gigas* Cope, from the Cretaceous of Kansas is closely allied to *Sphargis coriacea*, though a much larger species, the length being 12.8 feet and the width from tip to tip of the anterior flippers, 11.3 feet.

Two other species, *P. neptunia* and *P. tuberosa*, the former from the Cretaceous of New Jersey and the latter from the same formation in Mississippi, have also been described by Prof. Cope, which seems to prove that the genus Protostega was quite as prevalent in Cretaceous seas as is Sphargis in those of the present.

Unfortunately the specimen captured in Delaware bay and brought to Philadelphia, lived but a short time afterward; its death having been hastened by an injury received from a boat hook or other weapon during the struggle to capture it.

The chance of seeing such a huge denizen of the ocean was a rare one, however, and very many citizens, including some eminent naturalists, took advantage of it. As a precautionary measure, the animal was kept upon its back; nevertheless, the muscular power displayed by the creature when trying to regain its normal position was something remarkable. Especially was this the case just previous to dying, when, according to its owner's statement, the united efforts of four men were required to keep it in place.

During a quiet interval the subjoined measurements were taken by the writer, kindly assisted by that careful naturalist, Mr. John A. Ryder:

	Feet.	Inches.
Entire length of animal	6	7
Length of carapace	5	0
Greatest width of same	3	4
From tip to tip of anterior flippers	8	8
Greatest width of anterior flippers	1	0
From point of beak to edge of carapace	1	3
Diameter of neck	1	0
Elevation	1	4
Width of breast	3	0
Length of tail	0	6

As a subsequent measurement suggested no alteration of the figures given they may therefore be accepted as approximately

correct.. The weight of the animal, taken soon after its death, was 765 pounds; as much, perhaps, as the half dozen specimens I have alluded to would average.

It follows, therefore, that these were but a little more than half grown, or that 1200 pounds, the estimated weight of an adult, as given by Dr. Holbrook, is much too large. A further examination of the specimen, which was fortunately secured by Prof. Cope, will, doubtless, decide the matter. In the meantime, a few of the more prominent characters pertaining to the animal may be profitably referred to. For instance, the mode of respiration in Sphargis is peculiarly marked. This is apparently effected by inflating the throat with air until it is much enlarged, and then by closing the nostrils and contracting the throat, suddenly forcing the air back into the lungs. That this pumping process is common to all the Testudinata is known, but that it effects respiration is denied by Drs. Mitchell and Morehouse, who ascribe this function to the axillary and inguinal muscles.

A much wider difference is found in the skeleton. Thus, in Sphargis the vertebral column is entirely independent of the carapace, while in other genera it is co-ossified. It differs also in having the carapace disconnected with all the other parts of the skeleton. Another peculiarity consists in the carapace being composed of a vast number of small bony irregular tesseræ joined by minute suture. The plastron is also more rudimentary than that of other turtles, being represented by a mere oblong ring of bones. Of course these embrace the more prominent features. It is not improbable, however, that a careful study of the animal will develop other points of equal interest, in which event the cause of science will be profited.

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WERE THEY MOUND-BUILDERS?

BY S. L. FREY.

THE question as to whether the mound-builders extended their occupation as far east as Eastern New York is an open one; and while some relics recently discovered have led some writers[1] to the conclusion that they had, I think that we need much stronger proof before we are warranted in drawing this inference.

It is but fair to conclude, however, judging from analogy, that

[1] Wm. L. Stone, *Magazine of American History*, September, 1878; Prof. Geo. W. Perkins, Portland Meeting of the American Association; Smithsonian Contributions, II, p. 58.

some people occupied this section of country before the advent of the Iroquois, for we cannot think that previously to that time, this fertile land, abounding in fish and game, was entirely without inhabitants. Who these tribes were, Hurons, Shawanoes, or some more advanced people, is but a matter of conjecture. It is an interesting subject for investigation, and it may be the good fortune of some one yet to discover relics that will lead to an elucidation of the mystery.

In this paper I wish to call attention to and describe some ancient graves, and their contained relics, which I have recently opened and examined, leaving it for others to conclude from the premises which I shall furnish, whether these were simply Indian graves of an old date or those of another people.

I have known of the place, examined for many years, and had, with others, previously done some superficial digging, finding at one time, in a grave, thirty arrow-heads and a small copper awl. The latter, of which Fig. 1 is a drawing, might have been used for piercing holes in buckskin garments, but as implements for

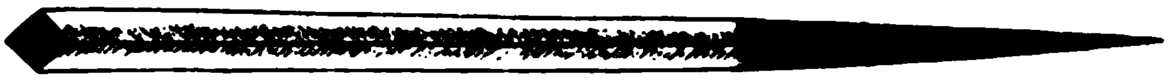

FIG. 1.—Full size.

this purpose were usually made of bone with the point rounded and sharpened in a similar manner, and as these were obtained with comparative ease and were equally serviceable for sewing purposes, I think that possibly this copper implement had a different, or at any rate an additional use. According to many early writers the natives at the time of the discovery, were found in possession of ornaments, necklaces, &c., of pearls, the perforating of which was done with a heated copper spindle. The square shape of this implement indicates that it has been set in a handle, and the point being very smooth, shows use of some kind. That it was intended for a drill of this description seems not improbable, when viewed in connection with certain shell relics subsequently found, and which are described in this article.

Aside from the above, as far as I have been able to learn, little had been found by others digging at this place. It is known as an "Indian burying-ground," and was originally an extensive knoll of sand and gravel with an upper stratum of loamy soil about four feet in thickness, mixed with angular fragments of sand rock. It has a southern exposure, and is abutted on the north by a precipitous rocky hillside. Unfortunately, however, the st of this old graveyard was removed years ago to make an

embankment for a railroad, and tradition says that many skeletons and relics were unearthed at this time, the bones being buried under the roadway, and that the relics, through the customary ignorance of the workmen, were destroyed and lost.

In Fig. 2 I have given a section of the place which shows the original form and what remains of the graveyard sufficiently well;

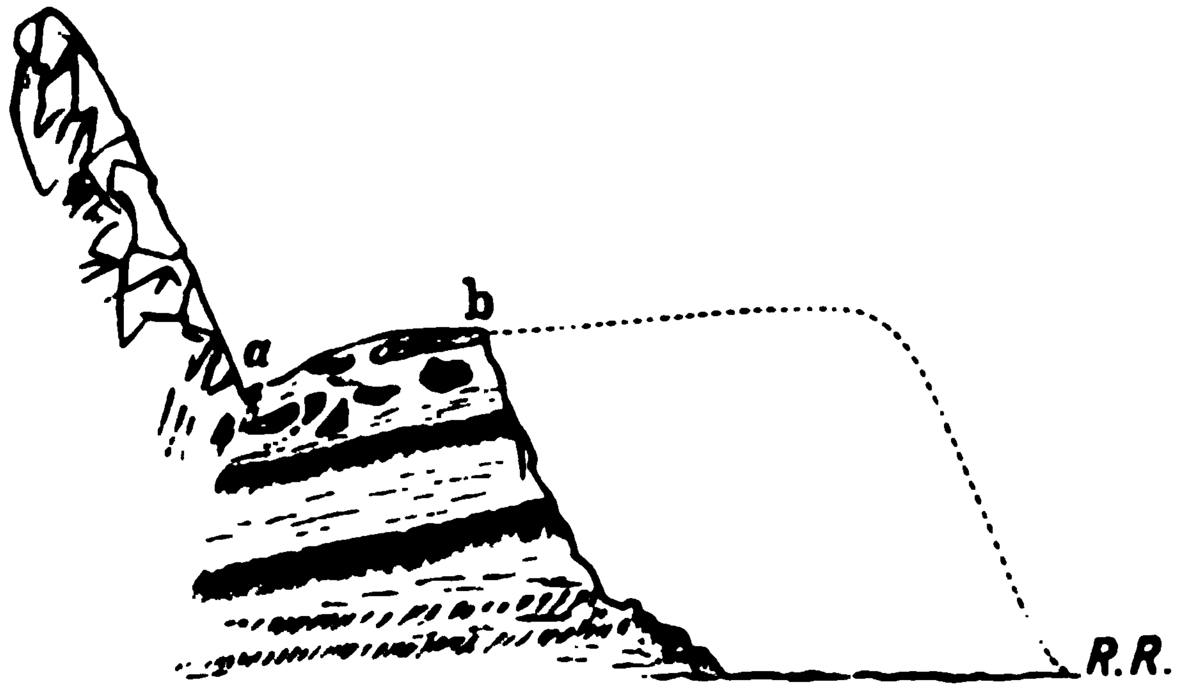

FIG. 2.

the point between *a* and *b* is where the graves which I opened were found; its conformation and the character of the soil suggested that it might have been somewhat artificially altered.

So much digging had been done previously to little purpose, that I had little faith that any graves remained undisturbed, but a friend of mine accidentally hearing that a curious pipe had recently been found, we visited the place one afternoon in November, too late, however, to do more than a little hasty and superficial digging. Examinations of places of this kind, containing graves of an ancient date, should of course be made with care, else will most of the bones and interesting relics be destroyed, or at any rate no satisfactory conclusion can be arrived at in regard to the manner of burial, probable age, &c.

Although our digging at this time was hasty, and done a little recklessly, I was fortunate in finding one grave, from which we obtained several relics of interest; the most curious being a tube, the shape and general appearance of which is represented by Fig. 3. This tube case, being covered with a dark earthy deposit, we were led at first to think was made of clay, but upon closer examination with a powerful magnifier, I am inclined to think that it is of stone, steatite perhaps. Under the glass there is none of that appearance of pounded shell or stone so generally observed in all early fictile fabrics. The rings and marks made by the boring tool are also plainly seen in all of them.

FIG. 3.—One-half natural size.

This tube is four and a quarter inches long, the perforation has at one end a diameter of one-quarter of an inch, gradually enlarging until it reaches at the other end a diameter of three-quarters of an inch.

Besides the tube, we found at this time a sea shell, somewhat modified for a drinking vessel, its longest diameter being four inches, a beaver's tooth, several bone awls, three arrowheads, a number of flint flakes, pieces of a tortoise shell, some fragments of deer horn implements, the bone gouge, Fig. 4, and a large wing bone of a bird.

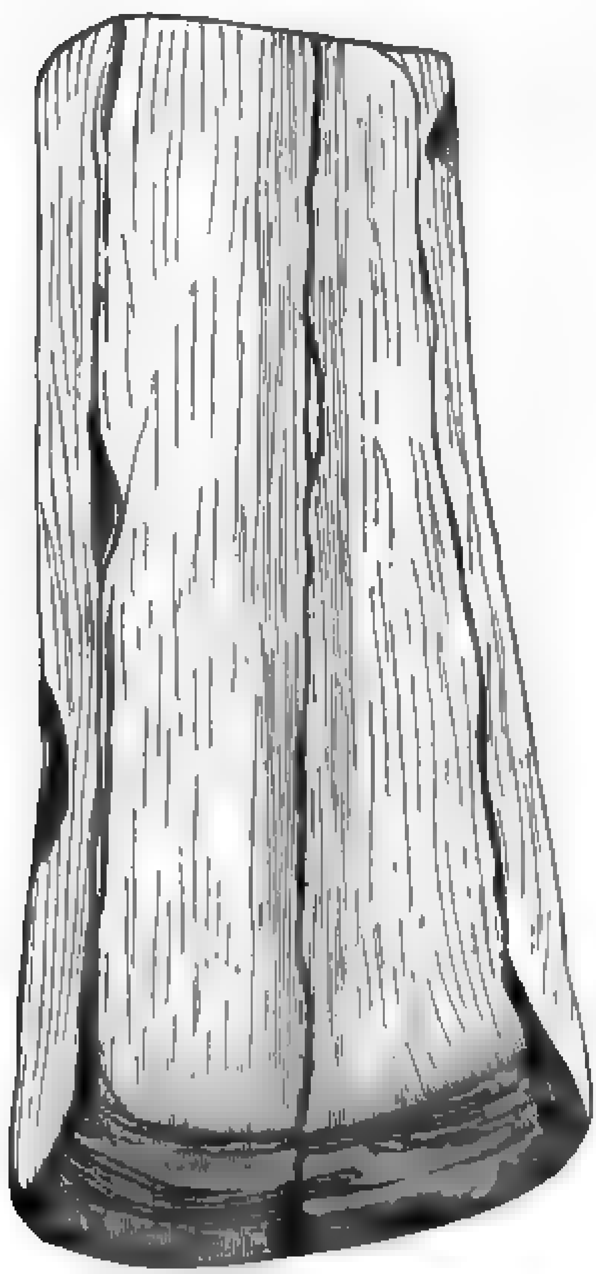

FIG. 4.—Bone Gouge, full size.

A few days after this I again visited the place with a couple of workmen, and prepared to give it a pretty thorough examination I commenced digging at the grave we had previously found, and cleared off a space several feet wide immediately below it, so as to be able to determine the manner of burial. I found that there had been two bodies buried in this grave, side by side, in a sitting posture, facing the east, a pit having been dug about three feet in depth and lined with flat stones previously to the interment. This manner of lining the grave I have not before seen, but all the graves examined were of this kind. Large boulders and angular pieces

of sand rock had, however, in some instances been rolled into or on top of the grave, a protection, perhaps, against wild beasts. The bones were very much decayed, so that it was impossible to save even the skulls.

In addition to the relics previously described I found another tube; it appears to be of the same material as the one already figured, but differs from it in shape and length. It is eight and one-half inches long and one inch in diameter, having a bore of five-eighths of an inch at one end and two-eighths of an inch at the other. It is smoothly made but has no polish at present, being covered with an earthy coat, and in patches with a thick concrete of lime and sand. With this tube were found lying side by side, three hornstone implements; they are respectively five and one-half, six and one-quarter and six and one-half inches long, and about one-quarter of an inch thick in the center, beautifully chipped and of perfect proportions, the material approaching nearer to flint than any other specimens found here, the conchoidal fracture being even and perfect, and the edges semi-transparent.

FIG. 5.—Hornstone Implement, full size.

The mineral seems to have been selected out of regard to its beauty, the points of all of them being lighter colored than the rest of the implement. In the largest one, Fig. 5, appears a small nucleus, around which

the mineral formed in concentric circles, shading off from the center to the circumference, and very much resembling some of the hornstone disks made from the material at Flint Ridge, in Ohio. The upper side of these implements was partially covered with the same kind of concrete which adhered to the tube. I have endeavored to show this in the engraving.

Proceeding into the side hill about six feet I came to another grave, the first indication of which was the red color of the surrounding earth; the body was at the same depth as the last, and the grave lined with stones in a like manner. Although the bones were too badly decayed to judge with certainty, I believe this to have been an extended burial, as the skull seemed to be in place, and on the same level as the pelvic and leg bones. The body had been buried with the head toward the west. The first object found was a piece of "slaty graphite" about five inches long, four inches broad and two inches thick, the surfaces of which are deeply grooved and furrowed, apparently with sharp flint-flakes or other stone tools. For what purpose these irregular grooves had been made it is difficult to say; they resemble those in the so-called sharpening stones, but as this material is soft it could not have been used for such a purpose. I think it probable they were made to obtain the powdered black lead for purposes of decoration, or in the manufacture of a pigment of some kind. This piece of ore and the ground for some distance around was covered with a red earthy deposit several inches in thickness, which had colored the earth and stones, as I first observed, as well as the bones and contained relics. In none of the other graves was so much of this red substance found, and none at all in some of them. It is without doubt red hematite, placed in the grave for some purpose.

Imbedded in this red ore I found two tubes, similar to those before described but longer, the perforation large at one end and small at the other, and the striæ and drill marks, showing plainly on the inside, indicate that the material is stone; they were nearly ten inches long and an inch in diameter. If the uses of these tubes were known, we might be able to conjecture why tw similar should have been buried in one grave.

Near the tubes, and also imbedded in the hematite what had apparently been a necklace or head-dress copper and shell beads; the former were badl

been made of thin sheets of copper rolled into tubes. That they had been worn around the head or neck was evident, for one side of the skull and the lower jaw-bone were stained a dark copper color. Many of the shell beads were also stained by the copper; those so colored retaining their original polish, being hard and glassy, like ivory, while those not so stained were brittle, many of them falling into a white laminated powder. The shell beads were fifty-nine in number, besides those that were too badly decayed to handle, and were from half an inch to one and three-quarter inches in length, and averaged about half an inch in diameter. They were of that kind so fully described by the early writers, made from the columellæ of large sea shells and rubbed and ground smooth with great labor, and afterwards drilled through their longest diameter with greater labor still. They were known by the names of "roanoke," "peak" and "wampum," and were worn by the southern Indians as nose and ear jewels, necklaces, etc. The drilling of these hard shells when iron tools were unknown, must have required patience and industry, and we may well look at them with wonder, and as evidences of the possession of these virtues by their unknown makers. The drilling had been done in most cases from each end, the holes meeting in the center. In some of the shorter ones, however, the perforations were made from one end, being of uniform size throughout. The spiral grooves where the whorls of the shell wound round the hard central column, can be seen in all of them. In addition to the beads and probably forming a central pendant to the necklace, there was found an elk's tooth. It is stained a beautiful copper color and highly polished.

On the same level as the last grave, and about six feet to the west of it, I came to another, similar in all respects, lined with flat stones. The body was apparently extended, with the head toward the south; the bones were nearly all decomposed. The relics found were the remains of a necklace of shell beads, little copper tubes and small sea shells about half an inch long, with a hole drilled in the large end. The only way that these latter can be strung is with a "waxed end" tipped with a bristle, such as shoemakers use. This follows the whorls of the shell, and it is the only way, apparently, in which they can be utilized as beads. Their makers may have had some other way, but I have not been able to discover it.

In addition to what has already been described, the workmen found two graves further to the east and lower down on the hill-side. The first contained merely a skull and a few large leg bones, the interment being unlike the others. The skull rested face down on the other bones, the ends of which had apparently been gnawed by some carnivorous animal, the tooth marks being plainly visible. From these circumstances I think the bones may have been collected on the surface and buried as I found them. The skull, although too much decayed to be taken out except in small pieces, was fully twice as thick as the others, with the ridges largely developed. The marked anatomical differences and the burial, so unlike the others, there being no relics found, would indicate that this man belonged to another people. At any rate little respect seem to have been paid to his remains.

The second grave contained nothing but the moldering skeleton of an individual who had been buried facing the west.

A few days after this I made another examination of this place, accompanied by a friend. At this time we found but one grave. It was a short distance west of the others, and similar to those already described, with the same lining of flat stones. The bones were at a depth of four feet, that being the deepest grave of any found. It was apparently an extended burial, the skull rested on a stone a little above the level of the body and faced the west. In this grave I found two shell beads and one hundred and eighty-nine arrow-heads; the latter were all of one type, leaf-shaped with truncated bases. They vary from one inch to two inches in length; the material is chert or hornstone; and they are sharp and chisel-like at the base, with serrated edges and sharp points. These one hundred and eighty-nine arrow-points to a savage people meant far more than we are qualified to appreciate. It was so much wealth, so much food-producing material rendered unavailable. What a vivid picture this old grave and the decaying bones of its occupant give us of the poverty of these stone-age people.

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RECENT LITERATURE.

GEOLOGICAL SURVEY OF INDIANA.[1]—These reports embrace descriptions of the geology of Wayne, Crawford and Harrison

[1] *Eighth, Ninth and Tenth Annual Reports of the Geological Survey of Indiana, made during the years 1876, '77, '78.* By E. T. Cox, State Geologist, assisted by Prof. JOHN COLLETT and Dr. G. M. LEVETTE. Indianapolis, 1879. 8vo, pp. 541, with maps.

counties, with a general survey of the geology of the State, and special reports on the economic geology. Considerable space is given to palæontology, Mr. S. A. Miller contributing a catalogue of fossils found in the Hudson river, Utica slate and Trenton groups, as exposed in the south-east part of Indiana, south-west part of Ohio and the northern part of Kentucky; while Prof. J. S. Newberry supplies a list of certain sub-carboniferous fishes, with descriptions of several new species; among them teeth much like those of the living rays, especially Myliobatis, the writer expressing "little doubt that they represent the oldest and most gigantic members yet known of the ray family." A good deal of space is devoted to the archæology of the State, but the chief interest of the report lies in the full account of the famous Wyandotte cave, illustrated by a large map. The geology and topography of the cavern, with adjoining caves, is given in detail, and for the first time we have mapped out one of the largest and most beautiful grottoes in the world. On one of the maps illustrating the reports is laid down the position of the numerous caves occurring in the subcarboniferous limestone called the St. Louis or cavernous limestone. Appended are Prof. Cope's observations on Wyandotte cave and its fauna, revised for this report.

HYATT'S COMMON HYDROIDS, CORALS AND ECHINODERMS.[1]—This is the fifth brochure of the series of Guides for teachers of science in schools. It is intended to supply such information as they need in teaching and are not likely to get from other sources. The style is clear and attractive, and the illustrations fresh and good enough for the purpose, and some of them drawn by Mr. Van Vleck for the book. In this connection we may draw attention to what was done the past winter by the Boston Society of Natural History, through its custodian, Prof. Hyatt. It was found in October that the assistance of the society was earnestly desired by those interested in the proper introduction of the study of nature in our public schools and in the cultivation of a faculty for observation among the school children, and it was resolved to institute appropriate courses of lessons for the teachers, if the means of paying expenses could be raised by donations. The necessary funds were secured by two ladies who are members of the society, which may congratulate itself upon such evidence of the activity and usefulness of this new class of its members. Fortunately for their success, these ladies met with appreciation from Mrs. Augustus Hemenway, without whose assurances of support and interest the society would not have dared to begin these courses at an estimated cost of three thousand dollars. Many of the schools contributed, in varying sums, to the amount of seven hundred and twenty-six dollars. The

[1] *Boston Society of Natural History. Guides for Science Teaching. No. V, Common Hydroids, Corals and Echinoderms.* By ALPHEUS HYATT. Boston, Ginn & Heath, 1879. 12mo, pp. 32.

rest of the subscription was made up by ladies, many of whom have been long known as patrons of similar undertakings or interested in public education.

Notwithstanding this generous assistance, it would not have been possible to carry on the several courses without the friendly aid of other institutions and individuals. The Institute of Technology very generously placed Huntington hall at the service of the society upon the payment of a mere nominal sum for the heating and care of the same. The Museum of Comparative Zoölogy gave hundreds of duplicate specimens; and several assistants and students of the society and institute gave material assistance. The Parker House and Young's Hotel gave freely such parts of birds as were needed to illustrate one lecture. All the teachers attending these lectures have been furnished with sets of specimens, amounting sometimes to ten or more, which they have studied under the direction of the lecturer, and taken away with them to use subsequently in their own instruction. In this way about one hundred thousand specimens have been distributed, and it is known that they have already materially assisted many teachers. Since this sort of lecturing was first instituted in the fall of 1871, under the patronage of Mr. John Cummings, there have been studied and distributed to teachers of the public schools about seventy-five thousand specimens of minerals, rocks, plants and animals. The applications for tickets rose during these years from fifty-five to one hundred and sixty-six, and during the present course to six hundred and sixteen, with an average attendance of about five hundred.

Recent Books and Pamphlets.—Oversigt öfer de af svenska Expeditionerna till Novaja Semlja och Jenissej 1875 och 1876 insamlade Hafs-Mollusker. Af Wilhelm Leche. 4to, pp. 86, pl. 2. (Extr. Kongl. Suenck. Veten-Akad. Handl., Bandet 16, No. 2.) Stockholm, 1878. From the author.

Uber die Entwickelung des Unterarms und Unterschenchels bei Chiroptera. Von Wilhelm Leche. 8vo, pp. 16, 1 pl. (Extr. Bihang till Kongl. Svens. Vet. Acad. Handlingar, Bd. 5, No. 15.) Stockholm, 1879. From the author.

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The Gardener's Monthly, Vol. XXI, No. 247, July, 1879. Phila. From the editor.

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The Oölogist, Vol. IV, No. 10, May, 1879. Utica, N. Y. From the editor.

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Thevetia iccotli and its glucoside. By David Cerna, M.D. 8vo, pp. 6. Philadelphia, Pa., 1879. From the author.

Estudio del Terremoto del 17 de Mayo de 1879. Por Mariano Barcena. 12mo, Mexico, 1879. From the author.

Proceedings of the Academy of Natural Sciences of Philadelphia, 1879, pp. 137–152. From the society.

On the Old Red Sandstone of Western Europe. By Archibald Geikie, LL.D., F.R.S., etc. Part I. 4to, pp. IV—345–452, pl. I. (Extr. Trans. Roy. Soc. Edinburgh.) Edinburgh, 1878. From the author.

Monograph of the Fossil Reptilia of the Wealden and Purbeck Formations. Supplement No. IX—Crocodilia (Goniopholis, Brachydectes, Nannosuchus, Theriosuchus and Nuthetes). By Prof. Owen, C.B., F.R.S. 4to, pp. 1–19, pls. I–IV. (Palæontographical Society.) London, 1879. From the author.

Description of fragmentary indications of a huge kind of Theriodont Reptile (Titanosuchus ferox Ow.) from Beaufort, West Gough Tract, Cape of Good Hope. By Prof. Owen, C.B., F.R.S., etc. 8vo, pp. 189–199, pl. I. (Ext. Quar. Jour. Geol. Soc., 1879.) From the author.

On the Fossils called "Granicones;" being a contribution to the Histology of the Exo-skeleton in "Reptilia." By Prof. Owen, C.B., F.R.S., F.R.M.S. 8vo, pp. 233-236, pls. 2. (Extr. from Trans. Roy. Mic. Soc., Vol. I, 1878.) From the author.

Eighth, Ninth and Tenth Annual Reports of the Geological Survey of Indiana, made during the years 1876, '77, '78. By E. T. Cox, State Geologist, assisted by Prof. John Collett and Dr. G. M. Levette. 8vo, pp. 541, with four maps. Indianapolis, 1879. From the State geologist.

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Proceedings of the Royal Geographical Society and Monthly Record of Geography, Vol. I. 8vo, Nos. 5 and 6, May and June, 1879. London. From the society.

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Parasites; a Treatise on the Entozoa of Man and Animals, including some account of the Ectozoa. By T. Spencer Cobbold, M.D., F.R.S., etc. 8vo, pp. 508. London, J. & A. Churchill, 1879. From the author.

A List of the Brazilian Echinoderms, with notes on their Distribution, etc. By Richard Rathbun, Assistant of the U. S. Fish Commission. (From the Trans. of the Connecticut Acad. of Arts and Sciences, Vol. V, 1878.) 8vo, pp. 19.

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Aztlan Chiromoztor, Eine ethnologische Studie. Von Dr. Gustav Brühl. New York, 1878. 8vo, pp. 16.

The Morphology of the Vertebrate Olfactory Organ. By A. Milnes Marshall. (Reprinted from the Quarterly Journal of Microscopical Science.) 8vo, pp. 43, 2 plates.

The Canadian Entomologist, XI, No. 7, July, 1879. 8vo, pp. 4.

The Mollusca of the Fiords near Bergen, Norway. By the Rev. A. M. Norman, M. A. (Ext. from the Journal of Conchology for January, February and March, 1879.) 8vo, pp. 71.

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GENERAL NOTES.

BOTANY.

PRECOCIOUS FLOWERING OF THE CITRUS POMONA.—On December 14, 1877, I sowed, at my place at Santa Fe lake, Florida, 289 seeds of the grape-fruit (*Citrus pomona*). This tree appears to be closely related to the shaddock (*C. decumana*), but the fruit is much smaller, being only a quarter to a third larger than a large-

sized orange; the bitter rind is smooth and of a dirty pale yellow. The seeds were slow in germinating, not appearing above ground for about eight weeks. When scarcely two inches high a blossom appeared at the top of one of the little seedlings. The flower, of fair size, was perfect in every respect, even to having the rich odor similar to that of the orange blossom, and was fully expanded on April 16, 1878, or when the little tree was only about two months old. I watched anxiously for the forming of the fruit, but this seems to have been too much to expect, for the flower fell away without exhibiting any evidence of having been fertilized. This progressive individual was, in other respects, not different from its fellow seedlings, nor did it seem to be injured by its premature efforts to produce its kind.

I have already sent the NATURALIST (see Vol. XI, p. 489, August, 1877) some notes on a similar precocity in the orange (*C. aurantium*), and now add an instance of this curious feature in another species of the same genus.—*Henry Gillman, Detroit, Michigan.*

BEES GATHERING HONEY FROM THE CATALPA.—At a recent meeting of the Philadelphia Academy of Natural Sciences I called attention to the fact that there existed large patches of nectariferous glands on the under side of the leaves, in the axils of the veins, of *Catalpa bignonoides*. Up to the present time the proof that the glands in question were nectariferous, rested only on the evidence of the taste of the secreted fluid and the presence of ants of both red and black species, apparently feasting upon the nectar. Since then I have found the common honey-bee gathering the nectar from the foliar glands with as much industry as from the flowers, the latter of which at the time the observation was made having fallen, so that there was positive evidence that the glands alone attracted the bees. Furthermore, the bees were seen to introduce their tongues into the axils of the leaves where the secretion was present in a visible quantity on the gland, and lap it up as when getting the nectar from flowers. The bees engaged at this work carried no pollen at the time, and were apparently devoted to getting the honey only.

These observations place the question of the saccharine nature of the secretion beyond any doubt, and make it probable that the Catalpa is valuable as a honey plant, and deserves a place in lawns, parks and pleasure grounds, on account not only of its beauty, but also from its economic value to the bee culturist.—*John A. Ryder.*

THE FERTILIZATION OF THE WISTARIA.—In front of my study windows grows a beautiful American Wistaria; the great purple racemes hanging in the open window fill the room with their delicate perfume. During the day the blossoms are usually visited by two or three brilliant little humming-birds, and by many

flies and bees, all attracted by the color, fragrance and nectar of the flowers. I have been interested in noticing the manner in which the insects, particularly the large humble bees, aided in securing the cross-fertilization of the blossoms.

As is well known the Wistaria bears papilionaceous flowers, like the pea, bean, etc., the wings of which clasp the closely appressed and somewhat coherent petals forming the keel, the latter inclosing the stamens and pistils. In the newly expanded flower, which has not been visited by insects, the stamens and pistils cannot be seen without parting the petals forming the keel; we then find the stamens united throughout the greater portion of their length, and then, together with the pistil, bent upwards at nearly a right angle; the reason of this abrupt bend will be seen farther on.

When a bee alights on the blossom it clings to the petals forming the wings, and thrusts its proboscis upwards under the base of the banner where the nectar is secreted; in doing this the weight of the insect presses down the wings and keel of the blossom and forces upwards the stamens and pistils and presses their extremities with considerable force against the thorax and abdomen of the bee. In this manner the insect becomes dusted with pollen from many flowers, some of which cannot fail to find its way to the sticky stigma which is ripe to receive it. When the bee has secured the sweets that it loves, and departs, the petals usually resume their former position with the stamens and pistils concealed. It is interesting to watch the workings of this curious plan for securing cross-fertilization in the Wistaria, as this plant, from the structure of its blossoms, seems to offer great obstacles to its accomplishment.—*Israel C. Russell, Plainfield, N. J.*

HUMBLE BEES AND THE GERARDIA FLAVA.—Some years ago I sent a note to the NATURALIST stating how the humble bees perforated the corolla of *Gerardia pedicularia.* I have, within a few days, noticed that they act in the same way, to a less degree, with *Gerardia flava* when growing in quantity. I came upon an unusually fine lot of this in Providence on the 3d of August, a very hot day. The bees were numerous, and in many cases directed their flight at once to the holes made by previous visitors on the upper sides of the corollas, near the base. Some flowers, however, were approached in the usual way. It is said that this burglarious proceeding is only noticed in the case of such plants as bloom profusely. The consequence might be in time a perceptible diminution of individuals, when, owing to less competition, the insects would act in a legitimate way, that is, approaching by the open tube.—*W. W. Bailey, Providence, R. I.*

PRUNUS PUMILA.—Growing on the sand ridges by the shore of Lake Michigan, at Pine and Millers, Indiana, are very large plants of this species. Most authorities state that the stems are

from six inches to two feet high, and trailing, a description that accords very well with the character of the plant where I have seen it away from the shore of the lake. On receding from the lake the size diminishes, and one does not have to go far to find the typical form. But here, stems four or five feet long and half an inch or more in diameter, are common; some attain the length of seven feet. Two that were measured had a girth, near the ground, of four and a half inches and five and a quarter inches, respectively. This gives a diameter of 1.43 and 1.67 inches. The stems trail but little, several spreading from the same root, much as in the common juniper, but of a more erect habit. They are decumbent, ascending or sub-erect. The fruit, when ripe, is about the size and color of the Morello cherry, and but slightly ovoid in form. In remarkable contrast with this sand cherry is the necklace poplar (*Populus monilifera* Ait.), generally a good-sized tree, fruiting abundantly in the same situation at the height of from five to ten feet. The conditions that favor the growth of the cherry, dwarf the poplar, and the former has the advantage in the struggle for existence on the sand dunes of the lake shore.—*E. J. Hill, Englewood, Ill.*

BOTANICAL NEWS.—To the *New Italian Botanical Journal* for July, F. von Müller contributes an article on the systematic position of the genus Donatia. L. Mecchiati records certain experiments on the emission of carbonic acid from the roots of plants. ——Lübken and Warming's Danish *Journal of Popular Science*, third number, contains a well-illustrated article on Schwendener's lichen theory.——In Trimen's London *Journal of Botany* for July, A. W. Bennett concludes his Polygalæ Americanæ novæ vel parum cognitæ. The August number reports the publication of the second part of Hemsley's Diagnoses of new Mexican and Central American plants, dated July, 1879; about eighty new species are described.——Coulter's *Botanical Gazette* for August, among other notes, prints one on *Salix balsamifera*, by M. S. Bebb; while J. M. Coulter contributes notes on parallel chorisis in the petals of *Campanula media*; on a 4-merous *Lilium philadelphicum*, and on two-parted cotyledons in Eschscholtzia. ——In the *California Horticulturalist* G. Eisen tells how to treat living plants received by mail. He submerged the plants, moss and all in two pints of tepid water and one teaspoonful of pulverized camphor for one hour; then spreading a layer of wet moss on a newspaper he sprinkled the moss with two teaspoonfuls of pulverized camphor gum; on this he opened the geraniums evenly, covering them with wet moss, and on the top spread another sheet of paper. In this bed the plants should remain over night. The next morning the plants should be potted and kept out of direct sunlight for a few days. The plants should be watered very sparingly with camphor water.——The Tenth Annual Report of the Geological Survey of Indiana contains a cata-

logue and check list of the trees and woody shrubs of America, north of Mexico, by John W. Byrkit. It occupies fifteen pages of the report. Mrs. Haines also contributes a list of the ferns, mosses, hepaticæ and lichens of Wayne county, Indiana.——*Grevillea* for March and June contains an article by Dr. M. C. Cooke, strongly opposing the "dual lichen hypothesis," proposed by Schwendener.——The death of the following botanists has recently been announced: Elisabetha, Contessa Fiorini-Mazzanti, author of many papers on Algæ, etc.; of Thilo Irmisch, well known for his memoirs on the morphology of Phanerogams; of E. Spach, a voluminous author of systematic works and papers; of Prof. Karl Koch, of Berlin, best known as a horticultural botanist, as was David Moore, the well-known director of the Glasnevin Botanic Gardens, Dublin, who died June 9th at the age of seventy-two years; Tilbury Fox, M.D., who had given attention to the part played by minute fungi in producing skin and hair diseases, died at Paris, June 7th. We may add to the list Wm. Schimper, who, according to Gray, was the schoolmate of Agassiz, and one of the first investigators of phyllotaxy; he spent most of his life in Abyssinia.

ZOÖLOGY.[1]

THE SPADE-FOOT TOAD IN NEW HAVEN, CONN.—For more than two years I have been looking for the "spade-foot" (*Scaphiopus holbrookii*) in and about New Haven, confident that it occurred here and that careful search would reveal it; but my efforts have been vain until very lately. Thursday, April 24th, I saw some children gathered around an object on the pavement of Prospect street, and I asked them what they had. They replied that they had dug up a toad in the next yard. You can imagine my surprise and delight to behold a real live "spade-foot," the first I had ever seen alive. They willingly gave it to me, and I carefully took it home with me and kept it alive in a large box with plenty of earth and a tub of water.

Tuesday morning (the 29th) I was shooting small birds near Fair Haven, when I heard a most peculiar bellowing from a pond near by. I am more or less familiar with all the ordinary sounds that come from a pond, and I jumped at the conclusion that I heard the "spade-foot." On reaching the pond I saw a sight I shall never forget; the pond was rather small, and was swollen and overflowing on account of the heavy rains of the two preceding days, and swimming all over the surface, and at times uttering their peculiar bellow, were forty or fifty of my long-sought friends. They would float or swim awkwardly along until they wished to favor me with a song, and then the accommodating soloist would suddenly assume a perpendicular position as if a plummet had been attached to his tail, his head alone show-

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

ing above the water, his white throat dilated till it was three times the size of the head, his mouth closed tight, he would sing his brief song and reassume his horizontal position. The pond was quite deep in the middle, but I secured some specimens to prove my statements on my return home.

When I passed the pond again in the afternoon the same programme was being carried out, but I could secure no more specimens. On my return home I put my toad with the one I found Thursday, and in a few moments the male (the last caught) had clasped the female very tightly and I was expecting to raise some tadpoles, but they buried themselves in the earth the next day without laying any eggs.

In the afternoon of Tuesday a friend of mine, Mr. W. H. Fox, found the Scaphiopus in a pond out on Prospect street, and secured quite a number of specimens together with some spawn which he thinks belongs to this toad.

The next day (Wednesday, April 30th) I visited my pond again with net and pails, but the birds had flown without leaving a sign. Not a toad was to be seen or heard, and no spawn but frog spawn could be found; but they may have dropped it in the deeper water in the middle of the pond, out of my reach and sight. Mr. Fox visited his pond also Wednesday, but could not find a toad except the common one (*Bufo americanus*).

When I brought my first specimen home she buried herself in the earth, but when I returned from Fair Haven she was swimming around in her tub of water like the rest of them, and when I put the male in they stayed in the water together. Wednesday morning when the toads in the two ponds had disappeared, my pair had also buried themselves again in the earth in their box. So I think I can judge of the movements of the free toads by watching the movements of my captives.—*Fred. Sumner Smith.*

THE SHEDDING OF THE TRACHEÆ AND DOUBLE COCOONS.—It is a physiological rule in insect growth that the lining of the tracheæ, and of such other parts as are more or less subject to the action of the air, is shed with the external skin. This is the case even with those ramifications of the tracheæ where the lining is not so fine as to be absorbed. I was somewhat surprised, therefore, to find Mr. Edward Potts, in a late number of the NATURALIST, recording the fact as something interesting and new.

The same remarks apply to his observations about finding two chrysalids in a single cocoon of *Bombyx mori.* These so-called double cocoons are of very common occurrence, mentioned centuries since in works on silk culture, and noticed by every one who has had much to do with the rearing of silkworms.—*C. V. Riley.*

RELATIONS OF THE CTENOPHORA TO THE JELLY FISHES.—Hæckel has recently published a paper in the Jena *Zeitschrift*, in which he describes and figures *Ctenaria ctenophora*, a medusa of

the family *Cladonemidæ*, which has an oval body with two long ciliated tentacles, causing it to strangely resemble the Ctenophore Cydippe or Pleurobrachia. Ctenaria inhabits the Pacific ocean, and is regarded by Hæckel as an immediate transitional form from Gemmaria-like Anthomedusæ to Cydippe-like Ctenophora. A full description and drawings will be published in a work soon to appear entitled "System der Medusen," to be illustrated with forty plates. He considers that the Ctenophora have originated from the order of Anthomedusæ and family Cladonenidæ, and adds a table showing the homologies between the Ctenophores and the Craspedote Acalephs.

SWIMMING POLYPES IN DEEP WATER.—Till recently the free-swimming polypes met with at sea, of which the Portuguese man-of-war is a familiar example, were thought to tenant only the parts close to the surface The hydrostatic air bladder found in many of them, and its nature, sometimes quite transparent, sometimes more or less blue, were in keeping with this kind of life. Exceptions to the rule, however, are now known to occur. In 1875, when the broken Atlantic cable was being recovered, living polype-like creatures were brought up from a depth of 1780 fathoms. Dr. W. Siemens presented them to the Zoölogical Museum in Berlin. More recently Prof. Studer, on board the German ship *Gazelle*, obtained several specimens, complete and fragmentary, from the deep water, and was able to examine some of the animals while still alive. Twenty-four such cases he records. The depth of sounding line at which these siphonophora were attached were more than 300 fathoms; eleven were brought from 1500 to 2000 fathoms, and six from less than 800. Dredges in operation at the same time to 200 fathoms depth brought in no such animals, and it is inferred that those caught could not have merely got attached in lowering or raising the line. The animals belonged to the known genus Rhizophysa, and a new one (Bathyphysa). They had comparatively small swimming bladders, but no bells. Prof. Studer notes that a depth of 1000 fathoms (the average in this case) corresponds to a pressure of 181.85 atmospheres. Water would hardly be condensed at this, but the gas in the bladder of course would. Still, supposing it atmospheric air, its specific gravity when so condensed (0.235) would still be considerably under that of the sea water (1.027). The gas in the bladder, in its efforts to expand, would balance the pressure of the water column. But the animal by contracting the muscular walls of the bladder, may condense the air more and so sink; or, by releasing the contraction, raise itself. Only, in order that the volume of the gas should keep proportional to the pressure, the bladder must not come into too high layers of water, else it will be in danger of bursting. This, indeed, seems to have occurred with Siemens' Bathyphysa.—*English Mechanic.*

Capture of a Saw-fish.—When riding on the beach at Galveston, Texas, on the 1st of April last, I noticed some Mexican fishermen drawing a seine to shore to which was attached a large saw-fish (*Pristis antiquorum*). The animal was not enclosed within the net, but some of the meshes had become engaged with the teeth of the saw, and by this attachment it was drawn several hundred feet towards the shore, the large dorsal fin alone showing above the water suggesting that a shark was entangled in the net, but if a shark it must have been a dead one, for not the least effort at resistance was made, nor even signs of life, for the object drifted in as lifeless as a log till it touched the bottom; then indeed it made a few spasmodic efforts showing terrific power, in which the head and saw were thrown high into the air and swung around in a fearful way, while the tail was lashed about, showing that a bullock could not have withstood the blows.

This demonstration did not last five seconds, but it had brought the monster considerably nearer the shore and into about one foot of water where she lay perfectly quiet. The Mexicans then cautiously approached and slipped a noose over the tail, which was very broad, though the body just above it was but a few inches in diameter. When an attempt was made to pull her to shore, she made one more effort though but for an instant, when she quickly resigned herself to her fate. After she was nearly clear of the water eight men could not pull her more than one foot at a time, but she was finally landed well up on the beach. I did not venture near enough to measure her, but judged her body was eleven feet and her saw four feet long. At the shoulders I judged she was eighteen inches broad; thence it gradually tapered to the tail.

The extraordinary feature was the immobility of the animal under the circumstances; she was drawn in several hundred feet by a twine not larger than a knitting-needle, and she suffered herself to be dragged through the sand, tail foremost, without the least effort at resistance, or the least motion to show that she was suffering. I would like to know if this is usual with this fish when captured?

I learned that three well-grown fœtal saw-fish were found in her.—*J. D. Caton.*

Intelligence in Canthon.—The observation of Mr. Powell in your May number (page 124) on earth-worms reminded me of a similar display of reason in a *Canthon volvens*, which I think is worthy to be noted. One summer day I took a walk in the woods and met a beetle of the above kind singly pushing forward its ball in a straight direction, when it arrived at a certain point there was a slight declivity and the ball rolled sideways down about a yard; the beetle followed, and reaching the ball mounted and looked around. Then it descended and went to work again,

moving the ball at a large angle to a point about one and a half yards forward of the point, where it deviated and then proceeded in the original direction to a heap of dry leaves; it stopped pushing, entered the heap and commenced to pull the ball in. Evidently the beetle mounted the ball as a lookout for the right way. I was astonished, and if told should hardly have believed it, but I saw it.—*Fred. Brendel, Peoria, Ill.*

THE CALIFORNIA GRAY WHALE.—A schooner load of bones of this species, gathered in Scammon's Lagoon, Lower California, recently arrived in San Francisco, and were sold to be ground as fertilizers. Having examined a large number of the bones I can complete the characters of the genus *Rachianectes*, which have been but imperfectly known. The cervical vertebræ are all distinct, and the second and third at least enclose a vertebral canal. A first rib (the only one not broken up) has two heads; two other short ribs, perhaps first and second, are united distally into a broad sheet of bone. It is uncertain how far the union of these ribs is constant. The scapula has both coracoid and acromion. The orbital process of the frontal is of medium width, somewhat as in some species of *Megaptera.*—*E. D. Cope.*

THE JAPANESE LAP DOG (*Dysodus pravus*).—Since describing this form (Proceedings Academy, Philadelphia, July, 1879), I have had the opportunity of examining three other specimens in San Francisco. The first, which is in possession of Mrs. E. H. Harford, presents the following dental formula: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pre-m. $\frac{3}{3}$; M. $\frac{2}{3}$ The animal is young, as the exterior cusps only of the second superior tuberculars protrude through the gum. There is no internal tubercle of the inferior sectorial. The first superior premolar is a rudimental cusp; the second is very small, while the third is subtransverse in position. The dog is said not to be of pure race, which, perhaps, accounts for the presence of an additional premolar in each jaw. There are still one less below than in *Canis*, and will probably be early shed.

A second specimen, in possession of Mrs. Sargent, has the typical dentition: I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pre-m. $\frac{2}{2}$; M. $\frac{2-1}{3}$. It is also young, as the milk inferior sectorial dropped from the gum as I examined it, and the outer edge of the second superior tubercular only is exposed. Curiously enough there is an inner tubercle of the inferior sectorial. This dog came from Yokohama, and is said to be pure. Its age is said to be three years and three months; it has been in possession of Mrs. Sargent two years.

The third specimen is of larger size, and is said to be ten years old. Its dental formula is I. $\frac{0}{1}$; C. $\frac{1}{1}$; Pre-m. $\frac{1}{1}$; M. $\frac{1}{2}$; no inner tubercle of inferior sectorial. The last true molar above has been shed, but the alveolus remains; this and the loss of the inferior incisors are characters plainly due to old age.

The above examples all maintain the characters of the genus

Dysodus. The hair of this species is rather long and is not curled, and is neither very coarse nor fine. Ears pendant. The colors in the three specimens are black and white, the former predominating in one, the latter in another.

The extra copies of the paper in which this species was described were issued during my absence from home, so that their date of publication was unfortunately omitted; this is August 23, 1879.—*E. D. Cope.*

ZOÖLOGICAL NEWS.—*The Rural Press*, August 2d, contains descriptions read before the Californian Academy of Sciences. It is unfortunate that these descriptions should appear in this heterodox manner, and we would urge the author to send his descriptions to some recognized scientific publication, where they may meet the notice of ichthyologists. The new forms are *Glyptocephalus zachiras*, *Chitonotus megacephalus* and *Caulolatilus princeps*, all from the Pacific coast.——A zoölogical station has been established in Scotland at Cowie, near Stonehaven, the work to be carried on under the direction of Mr. G. J. Romanes, in connection with Aberdeen University.——Dr. J. F. Brandt, the veteran Russian naturalist of St. Petersburg, died August 7th, aged 77. He left valuable manuscripts which will be published.——Prof. Allman's address as president of the British Association, began at Sheffield, August 20th, was on protoplasm.——Cobbold's Parasites: a treatise on the Entozoa of man and animals, will prove useful to students and medical men.——A reply to Principal Dawson's criticism of Mœbius' work on Eozoön by Mœbius himself appears in the *American Journal of Science* for September.——Lubbock's scientific lectures just published by Macmillan & Co., will interest zoölogical students.——Mr. Moseley's Croonian lecture for 1878 was on the Stylasteridæ, a family of Hydroid stony corals.

ANTHROPOLOGY.[1]

ANTHROPOLOGICAL NEWS.—The second number of *Revue d'Anthropologie* for 1879 contains several papers of great importance. The first one is that by M. Florentino Ameghino upon pre-historic man in La Plata. The article is based upon an anthropological exhibit in the late Paris Exposition from the Argentine Republic. The author prefaces his discussion of the antiquity of man in La Plata with a chapter upon the American Aborigines, their antiquity and origin, in which he has brought together with rare diligence, from many literary sources, theories and statements concerning his subject. While many of these unproved opinions are stated only to be repudiated, others are retained and used as the bases of arguments which have no value whatever. The following story will suffice as an example: The Scandinavians were preceded by the Irish. An Irishman named Ari was driven by a tempest to

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

Huitramanaland, or later, in 999, he was seen by Biorn Asbrandson, a person who figures in the history of Scandinavia. And recently has been found near the Potomac, twenty kilometres from Washington, the burial place of Syasi, a woman that an ancient Irish manuscript, anterior to the year 1057, speaks of as having been killed by the Skrellings (Esquimaux) in an expedition to Huitramanaland. The grave was indicated by the following inscription: "Here rests Syasi, the blonde, from the eastern Island, widow of Kjoldr, sister of Thorgr by his father, aged 25 years. God be gracious to her. 1051."

It would be exceedingly unfair to judge of M. Ameghino's second and third chapters by the first, though the strong tendency is to believe that if he is so unreliable with reference to those things with which we are familiar, he is not to be trusted on ground unfamiliar to us. In fact, M. Ameghino is at home in La Plata, and speaks *ex cathedra*, while in the former chapter he quotes from others. The following is the author's classification of the archæological epochs:

Geological epochs.	Geological periods.	Archæological Epochs.	Sub-periods.
Post-tertiary	Post-pampean	Neolithic	Modern and ancient times
		Mesolithic	Mesolithic times
	Pampean	Paleolithic	Times of the great lakes
			Modern pampean times
			Ancient pampean times

A perusal of the paper will soon convince one that diligent workers are not wanting in South America; and omitting the worthless stories in the first part of the communication, the author's researches are to be highly commended.

The paper on the ancient inhabitants of the Canaries, by Dr. Verneau, and that on the series of the crania of assassins deserve careful study.

The able reviews by the most distinguished anthropologists of France, the miscellaneous notes and the bibliography make the *Revue a'Anthropologie* an indispensable auxiliary to the student of our favorite science.

The *American Antiquarian* has reached its fourth number and completed its first year. The contents of the present number are as follows: The emblematical mounds of Wisconsin, by J. N. De Hart, M.D.; Shell beds of Clatsop beach, by H. B. Clarke; A comparison between the the archæology of Europe and America, by the editor; The Utes of Colorado, by N. C. Meeker; Early Indian migrations in Ohio, by C. C. Baldwin; An exhibition of Indian character, by W. L. Coffinbury; The discourse of Dr. Broca at the opening of the International Congress of Anthropological Science in connection with the Universal Exposition at Paris, August 16, 1878; Indian music, by Rev. M. Eells; Pre-

historic manufacturing village in the Miami valley, by I. H. Benkley. The usual amount of current notes closes the volume.

The editor, in his letter to contributors, says that in the editorial department the *Antiquarian* has succeeded beyond his expectations. Of course magazines cannot be run without money, and in this regard the friends of anthropology must stand by the magazine.

The editor of these notes in the NATURALIST, under the kind favor of Prof. Baird and Major Powell, has been engaged in collecting materials for an atlas of North American antiquities and a dictionary of North American Indians. For the purpose of encouraging the former the Smithsonian Institution has issued a pamphlet of directions to observers, which can be obtained in any number by writing to the Smithsonian Institution. The work on the latter, or the dictionary of tribes, has reached the astounding number of ten thousand names. Of course there were never that many tribes in North America, but some tribes have nearly a hundred names. These names are of two kinds, autonyms and heteronyms. The former may be tribal or consanguineous, the latter may be Indian or Aryan, and either may be contemptuous or descriptive. The Aryan names have the further embarrassment of being written in English, French, Spanish and Dutch, and not always on the same phonetic system at that. Such papers as that of Mr. C. C. Baldwin in the *Antiquarian*, are of incalculable value to the summarist, and we take this method of expressing our thanks and calling for more.

Mr. E. A. Barber, in charge of the archæological department, Permanent Exhibition, Philadelphia, has gone to work in earnest to make his portion of the exhibition a success. It is the intention of the Council to establish a permanent loan exhibition of prehistoric relics; by which is meant that the exhibition and not the loan is to be permanent. Every guarantee of safe return of specimens is promised, and the exhibition will, no doubt, be successful.

The Appletons have brought out in good style, Hæckel's Evolution of Man, a review of which by Mr. Lester F. Ward was noticed in the July number of the NATURALIST. It is impossible in a short notice to review a work of such magnitude. No doubt it is a most exhaustive treatise on the biology of the human race, and the scientific reputation of the author must give it a wide circulation. The author's opinion "that a really scientific study of nature can no more dispense with philosophic reflection than can healthy philosophy ignore the results of natural scientific experience," leads him to apply his theory to all phenomena, material and spiritual. Furthermore, the political influence of the clergy in Germany has brought them into sharp conflict with men of science and politicians. The work of Prof. Hæckel is filled with bitter invective, which is little appreciated in a land of free thought, free speech and free religion.

The first number of the *Folk Lore Record*, published by the Folk Lore Society of London, is a charming volume on a delightful subject. The following papers are given in this number: Some West Sussex superstitions lingering in 1868, by Mrs. Latham; Notes on folk tales, by W. R. S. Ralston; The folk lore of France, by A. Lang; Some Japan folk tales, by C. Pfoundes; A folk tale and various superstitions of the Hidatsa Indians, by E. B. Tylor; Chaucer's night spell, by William J. Thoms; Plant lore notes to Mrs. Latham's West Sussex superstitions, by James Britten; Yorkshire local rhymes and sayings; Divination by the blade-bone, by William J. Thoms; Index to the folk lore in the first series of Hardwick's Science Gossip, by James Britten; Some Italian folk lore, by Henry Charles Coote; Wart and wen cures, by James Hardy; Fairies at Ilkley Wells, by Charles C. Smith; Notes; Queries; Notices and News.

Our readers will be pleased to hear that Maj. Powell, Col. Garrick Mallery and Mrs. A. R. Marvine are rummaging the entire literature of North American Aborigines with a view to publishing an exhaustive work on American Indian mythology.

The February number of *Materiaux pour l'Histoire de l'Homme* contains a very good résumé of the meeting of German anthropologists in 1878. The rest of the number is occupied with local European archæology.

In No. 5 of *Correspondens-Blatt* Prof. Stieda reviews a work entitled Materialen zur Vorgeschichte des Menschen im östlichen Europa. Nach polnischen und russischen Quellen bearbeitet und herausgegeben, von Albin Kohn und Dr. C. Mehlis. Jena, Costenoble, 1879.

GEOLOGY AND PALÆONTOLOGY.

Development of the Trilobites.—The Utica Slate and related formations. Fossils of the Utica Slate and metamorphoses of *Triarthrus becki*, by C. D. Walcott. (Transactions of the Albany Institute, Vol. x, p. 38, pls. 2.) The author in the above-mentioned articles gives the known distribution of the rocks of the Utica slate and a comparison of it with the Galena limestone, the Triarthrus beds of Cincinnati, the Orthis bed of Tennessee, the Thebes sandstone and the Graptolitic shales of Virginia, Tennessee and Alabama. The author is opposed to applying the term Cincinnati "to any group, epoch or period of Lower Silurian rocks." In the second part are given descriptions of two new genera and ten new species, making a total of one hundred species now known from the Utica slate. The development of the trilobite, *Triarthrus becki*, is given nearly complete. Barrande has classified the modes of development of the trilobites into four orders: 1st. Head predominating, incomplete; thorax rudimentary or wanting; pygidium wanting. 2d. Head distinct, incomplete; thorax wanting; pygidium distinct, incomplete. 3d. Head com-

plete; thorax distinct, incomplete; pygidium distinct, incomplete. 4th. Head and thorax complete; pygidium distinct, incomplete.

With regard to *Triarthrus* our author says: "We find *Triarthrus becki* placed doubtfully at the end of the third order on the description given by Prof. Hall. We cannot remove it from that position, as the youngest stage we have shows one segment in the thorax, but from the changes that occur in its development we cannot avoid the conclusion that with more complete material it will be removed to the second order, as the smallest individual is one millimetre in length, and the head and pygidium are strongly lobed and well developed." Two beautiful plates illustrate the new species and the various stages of the trilobite.—*J. S. K.*

GEOGRAPHY AND TRAVELS.[1]

AFRICAN EXPLORATION.—The Portuguese are about sending out another expedition, under Capt. Paiva d'Andrada. This party is to continue the exploration of the Zambesi river, and to form commercial and agricultural colonies in the neighborhood of Tete and the abandoned station of Zumba, which was once the furthest point occupied by the Portuguese on the river.

The party sent out from Livingstonia in August, 1878, to explore the western shore of lake Nyassa, after reaching Kuta bay, as mentioned in the NATURALIST for June, 1879, returned home, part of the way by another route, reaching Livingstonia on November 9th. Another attempt is soon to be made by the missionaries to obtain a better site for their station than the present one. They hope to find it between the Nyassa and the Tanganyika.

The East African Expedition of the R. G. S., under Mr. Keith Johnston, left the coast for the interior on the 19th of May. The natives in his employ numbered 138. He communicated to the society the route which he intended to take,[2] and upon which he was to proceed south-westwardly from Dar es-Salaam, and would be likely to obtain abundant supplies of food. He had previously made a short trip to Usambara. "This journey," he remarks, "furnishes an excellent specimen of the sort of traveling we shall have, and took us through a country which may be taken as an epitome of all Africa. There was a little bit of arid, level, uninhabited desert, a bit of undulating, cultivated and populous country, and beyond that a tract of mountain forest and stiff climbing. The magnitude of the trees and the density of the forest [illegible] anything I had imagined in Africa, and reminded [illegible] Paraguay, only here there is much less variety [illegible]

But this expedition, starting under such [illegible] already been deprived of its young [illegible]

[1] Edited by ELLIS H. YARNALL, Philade[illegible]

[2] Proceedings of Royal Geographical S[illegible]

died from dysentery, at Berobero in Khutu, 130 ...-Salaam, on the 28th of June.

... to record the death, on the 10th of July last, of ... Mullens, who left England in April of this year to ... the Tanganyika Mission of the London Missionary ...

... states that the Universities' Mission in Eastern ... recently established a new station at Newala on the ..., forty miles nearer lake Nyassa than their original ... at Masasi.

... Debaize arrived at Ujiji on April 2d. He intends to ... depot in the Uzighé country at the north end of lake ... He then expects to be able to establish another ... the mouth of the Aruwimi, on the Congo—a very bold ... undertaking. He will then explore the countries ... the southern end of the Albert Nyanza and lake Tan-... It is much to be desired that the very good fortune ... far attended him will continue to be enjoyed by this ... and skillful leader of the French Scientific Expedition.

... Belgian Expedition was, at last accounts, concentrated at ... where they expected to remain until the end of the rainy ... in May. An entomological collection has been forwarded ... Dutrieux. The Belgian Society have chartered a steamer ... out supplies for the expedition to the mouth of the ... A small steamer in sections, three steam launches and ... flat bottomed boats, none of which will draw more than a ... water, are also sent. This little flotilla is commanded by ... Loesewitz, who has a crew of forty seamen accustomed to ...pical climate and engaged for three years. It is hoped thus ...ach a point where M. Cambier and his party can communi-... with them. It is further reported that Mr. H. M. Stanley, ... having made rapid surveys of the streams emptying on the ... coast near Zanzibar, and engaging a large number of his old ...owers has left Zanzibar, and is expected to take command of ... section of the Belgian expedition.

The French Algerian Missionary parties have each reached ...eir respective destinations on the Victoria Nyanza and the Tan-...nyika lake. The Victoria party are reported to be very desti-... They have heard of the arrival of the Church Missionary ...iety's reinforcements at Uganda from Egypt and the Nile. ...other band of priests is to leave Algeria shortly to join their ...mpanions.

The Church Missionary Society has established a permanent station at Mpwapwa, where they have twenty-five acres of land under cultivation. This is topographically the most important place between the coast and Unyanyembe, as all the caravan roads converge to it. Its elevation above the sea is 860 metres. Two ... of the agents of this society have reached the southern

extremity of the Victoria Nyanza. A recent number of the *Church Missionary Intelligencer* gives an account by the Rev. C. T. Wilson of his voyage across the great lake from Uganda to Kagei. South of the Kagera or Kitangule river the low forest-covered shore gives place to high downs ending in abrupt precipices 300 or 400 feet high. North of the Kagera the rocks are mostly a hard conglomerate, the matrix being a clay iron ore, in which quartzite pebbles were imbedded, but on the south they are clay slate with red sandstone, the strata being inclined in a westerly direction at an angle of about fifteen degrees.

The American Board of Foreign Missions having recently received a large bequest, is desirous of establishing a mission in Africa, but finds nearly every portion of the coast occupied or at least prospected! They will probably choose a site in the interior where certainly there can be no difficulty in finding an unoccupied field.

The King of the Belgians has presented the International African Association with four Indian elephants. They have arrived safely at Zanzibar from Bombay, and have been landed near Dar-es-Salaam. An elephant will convey fifteen ordinary porters' loads of sixty pounds each, so that seven elephants would be able to carry as much as one hundred porters.

OBITUARY.—The following appeared in the London *Athenæum* of August 9, 1879: "Mr. Keith Johnston is no more. A son of the eminent geographer, Alexander Keith Johnston, the deceased gave early promise of fulfilling to the utmost the expectations of his friends. Carefully trained under the eye of his father and at Perthes's Geographical Institute under Dr. Petermann, he exhibited equal skill as a compiler of maps and a writer on geographical subjects. Amongst his latest works are a volume on 'Africa,' recently published by Mr. Stanford, and a 'Book of Physical Geography,' intended for the use of schools. An expedition to Paraguay showed that he also possessed the qualities demanded of a geographical explorer, and the work then done by him fully justified the choice of the Royal Geographical Society when they placed him at the head of an expedition intended to explore the country between Dar-es-Salaam and lake Nyassa. His report on a preliminary trip to Usambara gave promise of an exhaustive and trustworthy account of his further researches, such as is but rarely furnished by African 'pathfinders.' It was not to be. Still a young man, not yet thirty, he has joined that band of noble men who have laid down their lives in the cause of African exploration."

MICROSCOPY.[1]

AMERICAN SOCIETY OF MICROSCOPISTS.—This society assembled in Buffalo on Tuesday morning, August 19th, and adjourned on F[illegible] noon, the 22d. About sixty members were in attendance.

[1] [illegible]partment is edited by Dr. R. H. WARD, Troy, N. Y.

Important amendments were agreed upon to the proposed Constitution, and it was then adopted without opposition. At the suggestion of the National Committee on Micrometry, last year's resolution favoring the one-hundredth millimetre as the unit for micrometry was reconsidered, and the whole subject was then referred to the committee for further action. Mr. E. H. Griffith offered a silver medal as a prize, to be awarded at the next annual meeting, for the best two slides illustrating the adulteration of some common article of food. On Thursday evening a soirée was held in St. James Hall, which was well attended by the citizens of Buffalo. The following officers were elected for next year's meeting: President, Prof. H. L. Smith, of Geneva, N. Y.; vice-presidents, Dr. W. W. Butterfield, of Indianapolis, and Mr. C. C. Merriman, of Rochester; secretary, Prof. A. H. Tuttle, of Columbus, O.; treasurer, Mr. George A. Fell, of Buffalo. The day and place for the next meeting were left to be selected and announced by the Executive Committee. The president's address was delivered on Tuesday evening by Dr. R. H. Ward, in St. James Hall. During the week the following papers were read: On *Lernæocera cruciata*, and also on certain crustaceous parasites on fish, by Prof. D. S. Kellicott; on the structure of the spinal cord in the marsipobranch fishes, by Prof. A. H. Tuttle; on the embryonic growth of the eustachian tube and middle ear, by Dr. Lucien Howe; on photography as an aid to microscopical investigations, by Dr. Carl Seiler; on Modern object glasses, and on a universal microscope stand, by Prof. J. E. Smith; on the systematic examination of objectives for the microscope, by Dr. G. E. Blackham; on the Preparation and mounting of double stainings, by Mr. C. C. Merriman; on the Microscopical examination of the nerve centres, by Dr. Theo. Deecke; on the Microscopical work at the Department of Agriculture, by Thos. Taylor; on the Destructive powers of certain insects, by Mr. C. M. Vorce; on Microscopical organisms in drinking water, by Prof. S. A. Lattimore; and on the Illumination of fine rulings, by Dr. W. B. Rezner. After adjournment the few members who were able to remain for that purpose, enjoyed a most agreeable excursion to Niagara Falls as the guests of the citizens of Buffalo, of whom many of the most cultivated and accomplished accompanied the party.

American Association for the Advancement of Science.—This great society held one of its most successful meetings at Saratoga Springs during the week commencing August 27th, under the presidency of Prof. Geo. F. Barker. More than one hundred and fifty papers were presented, many of them being of exceptional value. Among those pertaining to microscopy may be mentioned those on the Physics of microscope objectives, by Romyn Hitchcock; on the Histology of insects, by Chas. S. Minot: on a Standard meter and its subdivisions into equal parts,

and on First results from a new diffraction ruling engine, by Prof. Wm. A. Rogers; on Crystallization of Canada Balsam, by Prof. Geo. F. Barker; on the Occurrence of microscopic crystals in the vertebra of the toad, by Prof. H. Carrington Bolton. Prof. S. A. Lattimore was elected chairman, and Rev. A. B. Hervey, secretary of the sub-section of microscopy for the next meeting, which is to be held in Boston, commencing on the last Wednesday in August next, and which can hardly fail to be a large and enthusiastic assemblage.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science, Twenty-eighth meeting, Saratoga, Aug. 27 to Sept. 2, 1879.—Owing to the favorable place of meeting, the gathering of members was larger than for several years, nearly 260 members being present, and 154 papers, some of unusual interest, having been entered. Prof. O. C. Marsh, president of the St. Louis meeting, read an address as retiring president, on the History and Methods of Palæontology. Prof. George F. Barker, as president, made a brief introductory speech at the opening of the session. The following papers on biology, geology and anthropology were presented:

The succession of glacial deposits in New England........	Warren Upham
On the thinning out and absence of the Upper Silurian and Devonian formations in Tennessee. On a remarkable crinoidal form recently discovered in Tennessee, with exhibition of specimens	J. M. Safford
Recently discovered cupreous veins at Blue Hill, Me. The Green mountain anticlinal..........................	C. H. Hitchcock
Consonantal expression of emotion......................	Clarence J. Blake
On the fertilization of Yucca. Objects of sex and of odor in flowers..	Thomas Meehan
Philosophy of the pupation of butterflies, and particularly of the Nymphalidæ. The cotton worm in the United States; explanation of its work, and mooted points in its habits cleared up...............................	C. V. Riley
On the conditions to be fulfilled by a theory of life. On the histology of insects. On the anatomy of Plathelminthes..	Chas. Sedgwick Minot
A short biography of the Menhaden....................	G. Brown Goode
Practical illustration of the use of some new or little known anatomical and physiological instruments and apparatus. Notes on the anatomy of the cat's brain. On a cat's brain with the corpus callosum absent................	B. G. Wilder
On the occurrence of microscopic crystals in the vertebra of the toad (*Bufo americanus*). [With a note by A. A. Julien.]	H. Carrington Bolton.
The ethnical influences of physical geography............	Danl. Wilson
The development of the neuration in the wings of insects, as illustrated in the history of cockroaches.............	S. H. Scudder
On graphite from the Ducktown copper mine.............	W. L. Dudley
On the geology of Bermuda...........................	Wm. North Rice
Sexual differentiation in *Epigæa repens*. Homologies in the Lauraceæ. Note on the movement of the stamens of *Sabbatia angularis*..................................	Lester F. Ward
On the Triassic rocks of New Jersey....................	Geo. H. Cook

An apparatus for photographing natural history objects in a horizontal position. The inter-articular ligaments of the head of the ribs in the cat. A method of demonstrating the thoracic arch in animals..........................	S. H. Gage
The bud-blight insect. Some interesting insect habits and their development. A successful moth trap...........	W. S. Barnard
On the present condition of the work upon the palæontology of New York. Notes upon the genera Fenestella, Hemitrypa, etc. The fauna of the Lower Helderberg group in relation to the corals, Bryozoa and Echinodermata..	James Hall
On the molluscan dredgings in the Gulf of Mexico and vicinity by the U. S. Coast Survey steamer *Blake* in 1877-9. On the genus Pleurotomaria................	Wm. H. Dall
Gypsum sand..	A. P. S. Stuart
The geological action of the acid of Humus: I. On unconsolidated deposits; II. On solid rocks.................	Alexis A. Julien
On some pre Cambrian rocks in America and Europe. On the geology of Port Henry, N. Y....................	T. Sterry Hunt
On the anthracite coal fields of Pennsylvania and their rapid exhaustion	P. W. Sheafer
The newly discovered cave in Luray, Page county, Va......	Jno. W. Chickering, Jr.
A new form of unpolarizable electrodes for physiological research	H. P. Bowditch
On the species of Bornean orangs, with notes on their habits; illustrated by specimens...........................	Wm. F. Hornaday
The Interoceanic Canal problem........................	Edward P. Lull
On the progress of the Second Geological Survey of Pennsylvania	J. P. Lesley
Notice of the occurrence of rocks representing the Marcellus shales of New York in Central Ohio.............	R. P. Whitfield
The sign language of the North American Indians........	Garrick Mallery
Lake Erie and the Eries. Superstitions of the ancient inhabitants of the Mississippi valley relative to the rabbit. Superstitions among the ancient inhabitants of the Mississippi valley relative to serpents. Superstitions among the ancient inhabitants of the Mississippi valley relative to the owl. Superstitions among the ancient inhabitants of the Mississippi valley relative to thunder..........	J. G. Henderson
Exhibition of archæological objects.......................	S. S. Haldeman
Archæology of Champlain valley, giving a general account of recent discoveries..................................	Geo. H. Perkins
Archæology of Missouri.............	W. H. H. Russell
Notice of some deposits of alkaline salts in Idaho.........	Henry B. Nason
Archæological notes from Japan.......................	Edward S. Morse
Description of a polished stone implement found in Monkton, Vt..................................	John M. Currier
The substances of amber and jade, illustrated by remarkable specimens..	Mrs. E. A. Smith
On the explanation of hereditary transmission............	Louis Elsberg
The ethnology of the islands of the Indian and Pacific oceans; illustrated by a large colored map............	Albert S. Bickmore
On some large and remarkable stone implements of the southern mound-builders. On the pottery of the southern mound-builders..........	F. W. Putnam
The genesis of the serpentine of Reichenstein, etc.	R. B. Hare
On the surface limits of thickness of the Continental glacier in New Jersey....................................	J. C. Smock

The following officers of the association were elected for 1880, the meeting to be held at Boston, Mass.: President, Lewis H. Morgan, of Rochester; permanent secretary, F. W. Putnam, of Cambridge; general secretary, John K. Rees, of St. Louis; treasurer, William S. Vaux, of Philadelphia.

PROCEEDINGS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, March 11.—The following papers were read: On the nudibranchiate gastropod Mollusca of the North Pacific ocean, by Dr. R. Bergh, and On the variability of *Sphæria quercuum* Schw., by J. B Ellis.

March 15.—Dr. H. C. Chapman presented a paper for publication entitled, Notes on Amphiuma.

April 25.—Papers entitled, Placenta of *Macacus cynomolgus*, by H. C. Chapman, and Description of new species of Chirocephalus, by John A. Ryder, were presented for publication.

April 22.—Mr. Ryder described a new Pauropod from Fairmount Park, which he named *Eurypauropus spinosus*.

April 29.—Prof. Cope discussed the ancestry of the Rhinoceros family in the light of new material recently obtained from the western Tertiary.

May 6.—Prof. Cope described a new Saurian under the name of *Camarasaurus leptodcirus*.

May 13.—Dr. Francis Dercum made a communication on the muciferous system of fishes, in which he sought to show their relation to the sensory system, as well as some new points in their structure.

May 20.—Prof. Kœnig made a communication regarding plastic clays in reference to their microscopic features.

May 27.—Dr. Dercum presented some farther results of his study of the muciferous canals.

June 3d.—Mr. Martindale recorded the fact of the abundance of *Volvox globator* in the hydrant water of Camden, N. J. Prof. Cope discussed the geological position of the White river freshwater beds, assigning them to the same position as the Oligocene of Europe. He also offered some observations on the genus *Anchitlurium*, and characterized a new species as *A. præstans*.

June 17.—Dr. Leidy exhibited the plates of his new work on rhizopods from the report of the Hayden Survey, for the inspection of the members, and described a new form under the name of *Nebela retorta*. Prof. Cope exhibited a skull of the new fossil cat, *Nimravus brachyops*.

June 24.—Mr. Meehan called attention to a remarkable instance of variation in the ray-petals of the flower of *Lonas*, from none at all to a form as well-marked as in the ox-eye daisy. Mr. Ryder described the larva of his recently described *Eurypauropus*.

July 1.—Prof. Cope presented a paper on the genera of cats, in which a re-arrangement of the species was proposed on the characters presented by the form of the pupil of the eye and the specialization of the dentition.

July 8.—Dr. Leidy described and named a new fossil foot-track from the Pennsylvania anthracite coal shale. Prof. Cope discussed the principal characters of the genera of Canidæ, new generic names being proposed for two domesticated forms which con-
ntly present remarkable peculiarities of dentition. The first called *Synagodus*, the second *Dysodus*, each represented ne species which Prof. Cope believed had the same generic try as other domesticated dogs.

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HOW OUR ANCESTORS IN THE STONE AGE MADE THEIR IMPLEMENTS.

BY B. B. REDDING.

FLINT, obsidian, chert and other hard stones having a conchoidal fracture, manufactured into forms to be used as axes, chisels, knives, scrapers, spear and arrowheads, are found in nearly all parts of the world. They are almost the only remains of a race of people who inhabited the earth at a period so remote that they were contemporaneous with the wooly elephant, the cave bear, the Irish elk and other animals now extinct. These implements are often found in connection with the remains of these and other fossil animals. In one instance in Denmark a stone arrowhead was found imbedded in the bone of a deer which has been so long extinct that the species is only now known from its fossil remains. The people who made these stone implements lived in Palestine, ages before Tubal Cain, and in Egypt long before the first Pharaoh; their flint knives, axes and arrowheads have been found in Europe from Greece to Norway, and from France to the steppes of Russia; in Asia from India and the Malay archipelago to Japan and Kamtchatka; in America from Greenland and Alaska south through the United States, the West Indies, the valley of the Amazon and Peru to Terra del Fuego. They seem to prove that man was originally a savage, that he lived by fishing and the chase, and that civilization has been a long, slow and tedious process of evolution.

There is great similarity in these stone weapons and implements wherever found throughout the world. A spearhead or scraper, an arrowhead or celt from England, could not by its shape or peculiarity of manufacture be distinguished from similar

implements found in Denmark, Palestine, Japan or South America. The stones used might differ, but the mode of manufacture and general shape are nearly always the same. How our prehistoric ancestors could have made these stone implements ages before the discovery of the use of bronze or iron, has been the subject of many speculations among archæologists, and many theories have been advanced in support of these speculations. The general conclusion has been that they were chipped into the shapes we find them by blows from small stone hammers. It is, however, proper to state that Mr. John Evans, Sir John Lubbock, Mr. A. Morlot and other writers on prehistoric remains, have suggested that the observations of travelers, as to the modes pursued by savage nations in similar work, might afford a correct solution.

The theory that they were manufactured into the shapes we find them by blows from stone hammers, was generally received until after the publication, in the *Overland Monthly*, of the observations of Mr. E. G. Waite and the late B. P. Avery, and in the Smithsonian reports of a letter of Gen. George Crook, all of whom had had an opportunity to observe Pacific Coast Indians manufacture stone implements and chip them into perfect shapes without the aid of stone hammers. As, however, these Indians used iron or steel in their work, obtained from white men, it was thought they might have changed the processes pursued by their ancestors. From a late newspaper paragraph I see that Mr. F. H. Cushing, who is connected with the Smithsonian Institution, by independent observation has arrived at the conclusion that the stone implements were not chipped into shapes by blows, but that the small flakes were broken out by pressure, and that to prove his theory he made a flint chisel, chipping it into shape by pressure with the aid only of a piece of hard wood.

Having had an opportunity to see a stone arrowhead made by a man, practically still living in the stone age, without the aid of any implement other than those found in a state of nature about him, and taking notes at the time of each act of manipulation and every process, I have thought that a record of what I saw, added to those made by other observers, might have some value in determining the processes used in similar work by our remote savage ancestors.

Prior to the close of the Modoc war, the Wintoons or Cloud

River Indians were without firearms. Up to that time the few settlers who reside about the base of Mount Shasta made it a rule to permit no Wintoon to carry a gun. As there are no agricultural lands and no mines on the Cloud river, the Wintoons were left in almost undisputed possession of their prolific hunting grounds and to the inexhaustible supplies of salmon and trout with which that river abounds. The Wintoons had but little contact with Americans until after Mr. Livingston Stone established a station on the river for the taking of salmon eggs for distribution by the U. S. Government. Very few of these Indians as yet have guns, their principal reliance in the chase being upon their primitive but powerful bow and arrows. The arrow maker is still a man of great importance in the tribe.

While visiting the United States Fishery a few days since I expressed a wish to Deputy U. S. Fish Commissioner Livingston Stone, who has acquired a knowledge of the Wintoon language, that one of the best arrowhead makers of the tribe should make, in my presence, a stone arrowhead, using only such tools and implements for the purpose as were in use by the Indians before their contact with white men. These people are only now emerging from the stone age, and a record of their manufacture of stone implements may give an illustration of the methods pursued by our ancestors in the palæolithic age, ten or twelve or more thousand of years ago, when they lived upon the products of the chase of the fossil deer, the aurochs and the cave bear.

Promptly at 3 o'clock came Consolulu, an old man between sixty-eight and seventy-two years of age, gray haired but erect and vigorous. He had been for many years chief of the tribe, and was elected chief when a young man, because alone and unaided he had killed a grizzly bear with his bow. He brought, tied up in a deer skin, a piece of obsidian weighing about a pound, a fragment of a deer horn split from a prong lengthwise, about four inches in length and half an inch in diameter, and ground off squarely at the ends—this left each end a semicircle, besides two deer prongs (*Cariacus columbianus*) with the points ground down into the shape of a square sharp-pointed file, one of these being much smaller than the other. He had also some pieces of iron wire tied to wooden handles and ground into the same shapes. These, he explained, he used in preference to the deer prongs, since white men came to the country, because they were

harder and did not require sharpening so frequently. When asked where he obtained the obsidian, he answered from a place on the north side of Mount Shasta, about sixty miles distant; that in former days the land where it is found was claimed by the Yreka Indians, and as this stone was wanted by the Trinity Indians, the Yrekas and the Modocs, as well as the Wintoons, it was rarely obtained without a battle. The piece he had was a light-blue in color, and he valued it at twenty dollars; he stated that if it were white it would be worth forty or fifty dollars. I could not learn that white obsidian is harder or is worked with greater ease; its increased value is probably based on its greater rarity. After stating that in battle he had been twice wounded with arrows, once in the shoulder and once through the calf of the right leg, and showing the scars above the ankle where the arrow had passed through, missing the bone, and been drawn out at the other side, and further stating, with evident gratification at the recollection, that while the arrow was still in his leg he sent one of his own into the throat of his opponent, from the wound of which he had bled to death in a few minutes, he commenced the operation of making a stone arrowhead. Holding the piece of obsidian in the hollow of the left hand, he placed between the first and second fingers of the same hand the split piece of deer horn first described, the straight edge of the split deer horn resting against about one-fourth of an inch of the edge of the obsidian—this being about the thickness of the flake he desired to split off; then with a small round water-worn stone which he had selected, weighing perhaps a pound, he with his right hand struck the other end of the split deer horn a sharp blow. The first attempt resulted in failure. A flake was split off but the blow also shattered the flake at the same time into small fragments. He then repeated the operation, apparently holding the split deer horn more carefully and firmly against the edge of the large piece of obsidian. The next blow was successful. A perfect flake was obtained showing the conchoidal fracture peculiar to obsidian. This I purchased, and instructed him to split off another from which to make the arrowhead. He repeated the operation and was again successful, and I have no doubt he could, with only an occasional failure, have split up the whole piece in a few minutes into shapes for spearheads, knives and scrapers. The shape naturally taken by the obsidian when split off in this manner is that

of a spearhead, and it could be put to use, for this purpose, with but slight alteration. The thickness of the flake to be split off depends upon the nearness or distance from the edge of the obsidian on which the straight edge of the split deer horn is held at the time the blow is struck.

The flake having been obtained, I watched with much interest and attention the process of working it into an arrowhead.

He now squatted on the ground, sitting on his left foot, his right leg extended in a position often assumed by tailors at work. He then placed in the palm of his left hand a piece of thick well-tanned buckskin, evidently made from the skin of the neck of a

FIG. 1.—Obsidian Flake.

FIG. 2.—Arrowhead of Obsidian.

deer. It was thick but soft and pliable. On this he laid the flake of obsidian, which he held firmly in its place by the first three fingers of the same hand. He then rested the elbow on the left knee, which gave the left arm and hand holding the flake, firm and steady support. He then took in his right hand the larger of the two deer prongs, which, as has been stated, had its point sharpened in the form of a square file, and holding it as an engraver of wood holds his cutting instrument, he commenced reducing one edge of the circular form of the flake to a straight line. With the thumb of the right hand resting on the edge of the left palm as a fulcrum, the point of the deer prong would be made to rest on about an eighth of an inch or less of the edge of

the flake, then with a firm downward pressure of the point, a conchoidal fragment would be broken out almost always of the size desired. The point of the deer prong would then be advanced a short distance and the same operation repeated, until in a few minutes the flake was reduced to a straight line on one edge. As this operation broke all the chips from the under side of the flake, if left in this condition the arrowhead would be unequally proportioned, that is, the two cutting edges would not be in the center. He therefore with the side of the deer horn firmly rubbed back and forth the straight edge he had made on the flake until the sharp edge had been broken and worn down. The flake was now turned end for end in the palm of his hand and the chipping renewed. When completed an equal amount was taken from each side of the edge of the flake and the cutting edge was left in the center. It was now plain that the straight edge thus made was to be one side of the long isosceles triangle, the form of the arrowheads which is used by his tribe.

With the flake of obsidian firmly held in the cushion of the left palm and the point of deer horn strongly pressed on the edge of the flake, the effect was the same as the blow which split the flake from the larger piece. While, however, he was not always sure of the effect of the blow in splitting off the large flakes out of which to make the arrowheads, he in no instance appeared to fail in breaking out with the point of deer-prong the exact piece desired. The soft thick pliable piece of tanned deer skin on which the flake in his left palm was held, may have added to the cushion, but seemed to serve no other purpose than to save his hand from being cut by the countless sharp chips as they were broken off. One of the long sides of the arrowhead having been thus formed, the flake was turned over and the other side formed in the same manner. As, however, very much more of the obsidian had to be chipped away, he brought more pressure upon the point and broke out larger chips until the flake began to assume the shape desired, when the same care was exercised as when the first straight edge was made. In breaking out large or small chips the process was always the same. The pressure of the point of deer horn on the upper edge of the flake never appeared to break out a piece, which, on the upper side, reached beyond where the point rested, while on the under side the chip broken out might leave a space of twice the distance. Invariably when a line of

these chips had been broken out the sharp edge was rubbed down, the flake turned end for end and the chipping renewed on the other side. By this process the cutting edges of the arrowhead were kept in the same line. The base was formed in the same manner. No lines were drawn but he would occasionally look at his work as it progressed and chip on one side or the other to keep their proportions equal. The base of the arrowhead—opposite the point—when finished, is inserted in a slot made in the end of the wooden shaft, and is firmly tied to it by the tendons of a deer. To hold the arrowhead firmly to the shaft and to prevent the thread of deer tendon from interfering with the penetrating power of the arrow, a slot about one-fourth of an inch deep is chipped into both cutting edges of the arrowhead about one-fourth of an inch above the base. This causes the arrowhead to look as if it were barbed, but the object seems only to be to provide means by which the arrowhead may be firmly fastened to the shaft, at the same time avoiding the making of any obstruction to the penetrating or cutting power of the arrowhead. The chipping out of these slots was the last operation to be performed. It seemed to me more difficult than any other part of the work, and I thought that in this would be the danger of the loss of all the patient labor that had been expended. In practical operation it was the simplest, safest and most rapid of all his work. He now held the point of the well-shaped arrowhead between the thumb and first finger of his left hand with the edge of the arrowhead upwards, the base resting edgewise on the deer-skin cushion in the palm. He then used the smaller deer prong, which had been sharpened in the same form as the larger one, but all its proportions, in every respect, were very much smaller; its point could not have been larger than one-sixteenth of an inch square. He rested this point on the edge of the arrowhead where he desired to make the slot, and commenced sawing back and forth with a rocking motion, the fine chips flew from each side, the point of the deer horn descended, and in less than a minute the slot was cut. The arrowhead was turned over and the same operation repeated on the other edge. It seemed that by this process, if he desired, the arrowhead could have been cut in two in a very few minutes. He now examined his work in the strong sunlight and, being satisfied, handed me the completed arrowhead. It had taken him forty minutes to split the two

flakes from the large piece of obsidian and chip one of them into the arrowhead. A younger man, equally expert, would probably have done the work in half an hour. When I came to the purchase of the arrowhead and flake, I found they would cost seventy-five cents, payable in shells, *Dentalium entalis*, which he esteemed more highly than their value in money. The worth of the flake and arrowhead was not based upon the time or labor employed, but upon the value of the obsidian, as he offered for a dollar's worth of shells to give me ten arrowheads of the same shape and size made from the bottoms of glass ale bottles.

The celts, knives, chisels and scrapers of the stone age are all much simpler and more easy of manufacture than these semi-barbed arrowheads.

I doubt if stone hammers were used in their manufacture other than to split off the flakes from a large piece of flint or obsidian, and when thus used the blow was communicated through the split deer horn or a piece of hard wood in the manner I have described. The blow from a stone hammer direct on the flint or obsidian would be very uncertain in its results even in the most skillful and practiced hands. With the split deer horn the thickness of the flake and probable length could be determined with tolerable accuracy. Probably large chips could be broken from the edge of a flake by a slot in the end of a deer horn as is now practiced by the natives of Alaska with a walrus tusk, used as I have seen window glass broken with a key, but an arrowhead is too small and delicate for either operation.

I cannot but believe that our prehistoric ancestors in the stone age used the same processes as were followed by Consolulu, and that in describing what he did I have told how the remote ancestor of

> "The ancient arrow maker
> Made his arrowheads of sandstone
> Arrowheads of chalcedony
> Arrowheads of flint and jasper
> Smooth and sharpened at the edges
> Hard and polished keen and costly."

COLORADO PLANTS.

BY ISAAC C. MARTINDALE.

REALIZING the fact that all discoveries or observations, unless brought to the attention of the people in some way, cannot be expected to be of much advantage to them, I have prepared this article in the belief that some lover of flowers, who has been or may be traveling over the same route taken by myself, may find in it a help or an assistance in the prosecution of the study of botany, or in naming the specimens collected by the way.

The list of plants hereto appended is of the specimens collected while on an excursion of the members of the American Association for the Advancement of Science after the adjournment of the St. Louis meeting in 1878, and during the time of the meeting at St. Louis on the excursions around the city, chiefly near Cahokia, Illinois. The route taken from St. Louis was westward to Kansas city, thence by the Kansas Pacific R. R. to Denver, thence southward to Colorado Springs, Manitou, Garden of the Gods, Queens Cañon, Glen Eyrie and Pike's Peak, making the ascent by way of Engelmann's Cañon; continuing the journey from Colorado Springs southward to Alamosa and returning to Denver; thence by way of Clear Creek Cañon to Idaho Springs, Georgetown, Central city and Blackhawk, also visiting Boulder Cañon as far as the Falls.

The rapidity of travel and consequent difficulty in taking proper care of the specimens prevented a larger collection being made, yet it is believed it embraces the greater part of the plants that may be found on the line of the route traveled. About forty persons participated in the excursion, several of whom were interested in the botany of the region and made collections of plants; I have been favored with an examination of these, and think the list includes all or nearly all that were obtained. Mr. Thomas Meehan, of Germantown, State Botanist of Pennsylvania, was one of the excursion party, and having visited Colorado on two former occasions, was well informed about the plants, and rendered valuable service. Prof. Gray and Sereno Watson, of Cambridge, Mass., Dr. Vasey, of Washington, and others assisted in the naming of some of the more difficult species.

In the closing number of Vol. III of *Field and Forest*, published at Washington, D. C., may be found an article, by Lester F.

flakes from the large piece of obsidian and chip one of them into the arrowhead. A younger man, equally expert, would probably have done the work in half an hour. When I came to the purchase of the arrowhead and flake, I found they would cost seventy-five cents, payable in shells, *Dentalium entalis*, which he esteemed more highly than their value in money. The worth of the flake and arrowhead was not based upon the time or labor employed, but upon the value of the obsidian, as he offered for a dollar's worth of shells to give me ten arrowheads of the same shape and size made from the bottoms of glass ale bottles.

The celts, knives, chisels and scrapers of the stone age are all much simpler and more easy of manufacture than these semi-barbed arrowheads.

I doubt if stone hammers were used in their manufacture other than to split off the flakes from a large piece of flint or obsidian, and when thus used the blow was communicated through the split deer horn or a piece of hard wood in the manner I have described. The blow from a stone hammer direct on the flint or obsidian would be very uncertain in its results even in the most skillful and practiced hands. With the split deer horn the thickness of the flake and probable length could be determined with tolerable accuracy. Probably large chips could be broken from the edge of a flake by a slot in the end of a deer horn as is now practiced by the natives of Alaska with a walrus tusk, used as I have seen window glass broken with a key, but an arrowhead is too small and delicate for either operation.

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Ward, on "St. Louis and Botany," to which the reader is referred for a more minute account of the botanical features noticed there; it embraces some species not included in this article, as they were collected before I reached St. Louis. During the fall and early winter a series of articles appeared in the *West Jersey Press*, of Camden, New Jersey, descriptive of the entire journey, and giving a detailed account of the places visited. Lester F. Ward, who accompanied the excursion to Texas after the adjournment of the Nashville meeting in 1877, published a list of the botanical collections made on that occasion in the *Bulletin* of the Essex Institute, and it seems to me that if the results of the collections made on these annual excursions could be brought in some way before the people, it would be of great service to students and others engaged in scientific work.

The species collected in Colorado and not mentioned in Porter and Coulter's Flora are printed in *italics*, those collected in the vicinity of St. Louis are marked *, those collected on the line of the railroad before reaching Colorado are marked †.

†Clematis Pitcheri T. & G.
" ligusticifolia Nutt.
Thalictrum Fendleri Eng.
Anemone multifida D. C.
Ranunculus affinis R. Br.
" adoneus Gray.
Delphinium scopulorum Gr.
Argemone hispida Gray.
Corydalis curvisiliqua Eng.
Physaria didymocarpa Gray.
*Sisymbrium incisum Eng.
Erysimum asperum D. C., var. Arkansanum Nutt.
Lepidium intermedium Gray.
" montanum Nutt.
Cleome integrifolia T. & G.
Polanisia trachysperma T. & G.
" *gravæolens* Raf.
Silene acaulis Linn.
" Scouleri Hook.
Arenaria Fendleri Gray.
Talinum teretifolium Pursh.
Claytonia Chamissonis E. & L.
Sidalcea malvæflora Gray.
Malvastrum coccineum Gray.
Geranium Fremontii Torr.
†Vitis indivisa Willd.
Ampelopsis quinquefolium Mx.
Acer glabrum Torr.
Rhus aromatica Ait. var. trilobata Gr.
*Æsculus glabra Willd.
*Baptisia leucantha T. & G.
Lupinus argenteus Pursh, var. decumbens Watson.
Trifolium involucratum Willd.
Psoralea tenuiflora Pursh.
Petalostemon violaceus Mx.
" candidus Mx.
Astragalus mollissimus Torr. (?)
Sophora sericea Pursh.
*Desmodium canescens D. C.
*Phaseolus pauciflorus Benth.
† " diversifolius Persoon.
*Cassia nictitans Linn.
* " chamæcrista Linn.
Robinia Neo-Mexicana Gray.
Prunus Virginiana Linn.
Neillia Torreyi Watson.
Spiræa discolor Pursh, var. dumosa Watson.
Rubus deliciosus Torr.
" strigosus Mx.

Cercocarpus parvifolius Nutt.
Geum Rossi Seringe.
Fragaria vesca Linn.
Potentilla glandulosa Lindl.
" rivalis, Nutt.
" dissecta Pursh.
" fruticosa Linn.
" Anserina Linn.
*Rosa setigera Mich.
" blanda, Aiton, var. setigera Crépin.
Cratægus coccinea L. var.
Saxifraga bronchialis Linn.
" nivalis Linn.
" Jamesii Torrey.
" *chrysantha* Gray.
Jamesia americana T. & G.
Sedum Rhodiola D. C.
" stenopetalum Pursh.
Epilobium angustifolium Linn.
" paniculatum Linn.
Gayophytum ramosissimum T. & G.
†Œnothera coronopifolia T. & G.
†Gaura parviflora Dougl.
† " biennis Linn.
*Ludwigia polycarpa S. & P.
*Ammania latifolia Linn.
Mentzelia nuda T. & G.
" multiflora Nutt.
Echinocactus Simpsoni Eng.
Cereus viridiflorus Eng.
Opuntia Rafinesquii Eng.
" Missouriensis D. C.
" arborescens Eng.
Cucurbita perennis Gray.
†Echinocystis lobata T. & G.
Cymopterus anisatus Gray.
Ligusticum scopulorum Gray.
Symphoricarpus montanus H. B. K.
" occidentalis R. Br.
* " vulgaris Mich.
Galium asperrimum Gray.
† " trifidum Linn.
" boreale Linn.
*Vernonia fasciculata Mx.
Liatris punctata Hook.
Pectis angustifolia Torr.
Kuhnia eupatorioides L.
Brickellia Wrightii Gray.
" grandiflora Nutt.
*Eupatorium serotinum Mx.
Townsendia eximia Gray.
*Boltonia glastifolia L'Her.
Aster lævis Linn.
" multiflorus Aiton.
" falcatus Lindl.
" canescens Pursh.
" tanacetifolia H. B. K.
" *Pattersonii* Gray.
" glaucus T. & G.
" carneus Nees.
†Erigeron divaricatum Mx.
" grandiflorum Hook.
" bellidiastrum Nutt.
" macranthum Nutt.
" divergens T. & G.
" *ursinum* Eaton.
Gutierrezia Euthamiæ T. & G.
Solidaga Virga-aurea L.
" " var. multiradiata T. & G.
Solidago nemoralis Aiton, var. mollis Benth.
Solidago canadensis Linn.
Bigelovia graveolens Gray.
Aplopappus spinulosus D. C.
" pygmæus Gray.
" Parryi Gray.
† " ciliatus.
Grindelia squarrosa Dunal.
Chrysopsis villosa Nutt.
" " var. hispida.
Pericome caudata Gray.
*Iva ciliata Willd.
* " xanthiifolia Nutt.
*Ambrosia psilostachya D. C.
* " tridentata.
*Eclipta procumbens Michx.
†Heliopsis lævis Pursh., var. scabra.
Rudbeckia hirta Linn.
†Lepachys columnaris T. & G.
Helianthus lenticularis Dougl.
* " rigidus Desf.
" pumilis Nutt.
" *Maximilliana* Schrad.
Heliomeris multiflora Nutt.
*Coreopsis aristosa Mx., var. mutica.
Ximenesia encelioides Cav.
Dysodia chrysanthemoides Lag.
Gaillardia aristata Pursh.
Actinella grandiflora T. & G.

Artemisia [illegible]
" [illegible]
" [illegible]folia Torr.
" [illegible] Pursh.
" Ludoviciana Nutt.
" " var. gnaphalodes T. & G.
" frigida Willd.
" scopulorum Gr.
" " var. monocephala.
" *arctica* Less.
*Gnaphalium uliginosum Linn.
Antennaria dioica Gan.
Arnica alpina.
" mollis Hook.
Senecio eremophilus Rich.
" Bigelovii Gray.
" *Fendlerii.*
" *spartioides.*
" *rapiifolius* Nutt.
*Cacalia atriplicifolia Linn.
Cnicus eriocephalus Gray.
" *edulis* Nutt. (?)
Troximon glaucum.
*Lactuca scariola Linn.
† " elongata Muhl.
Lygodesmia juncea Don.
Campanula uniflora Linn.
" Scheuchzeri Vill.
" rotundifolia Linn.
Arctostaphylos Uva-ursi Spreng.
Pyrola secunda Linn.
Androsace chamæjasme Host.
" septentrionalis Linn.
Asclepias Jamesii Torrey.
* " verticillata Linn.
*Acerates longifolia Ell.
*Enslenia albida Nutt.
Gentiana Amarella Linn.
" " var. stricta Watson.
" frigida Hænke.
" Parryi Engel.
" affinis Griseb.
Frasera speciosa Dougl.
Collomia linearis Nutt.
" longiflora Gray.
Gilia aggregata Spreng.
" pinnatifida Nutt.
Phacelia circinata Jacq. f.
" *glandulosa* Nutt.
[illegible]otomum R. & P., var. angus-
[illegible] Gray.
Echinospermum Virginicum Lehm.
† " Redowskii Lehm. va
occidentale Watson.
Eritrichium crassisepalum T. & G.
" Jamesii Torr.
" glomeratum D. C., var. vir-
gatum Porter.
Mertensia alpina Don.
*Onosmodium carolinianum D. C.
Ipomea leptophylla Torr.
Evolvulus argenteus Pursh.
Cuscuta decora Chois.
Solanum triflorum Nutt.
* " Carolinense Linn.
" rostratum Dunal.
† " nigrum Linn.
Physalis hederæfolia Gray. (?)
† " lanceolata Michx.
" lobata Torr.
Pentstemon secundiflorus Benth.
" glaucus, Graham, var. steno-
sepalus Gray.
Chionophila Jamesii Benth.
Mimulus floribundus Dougl.
*Conobea multifida Benth.
*Herpestis rotundifolia Pursh.
*Synthris Houghtoniana Benth.
Veronica peregrina Linn.
*Gerardia purpurea Linn.
Castilleia linariæfolia Benth.
" miniata Dougl.
" pallida Kunth.
" breviflora Gray.
Orthocarpus luteus Nutt.
Pedicularis Parryi Gray.
" procera Gray.
*Ruellia ciliosa Pursh.
† " strepens Linn.
*Verbena stricta Vent.
" bracteosa Michx.
" Aubletia Linn.
*Teucrium canadense Linn.
*Mentha sativa Linn.
Hedeoma Drummondi Benth.
†Salvia azurea Lam., var. grandiflora Benth
† " lanceolata Willd.
Monarda fistulosa Linn.
†Blephilia hirsuta Benth.
†Lophanthus nepetoides Benth.
Dracocephalum parviflorum Nutt.
Plantago patagonica Jacq., var. gnaph-
alioides Gray.

Plantago patagonica var. aristata Gray.
Mirabilis multiflora Gray.
" oxybaphoides.
*Oxybaphus nyctagineus Sweet.
" angustifolius Sweet.
Abronia fragrans Nutt.
Chenopodium Fremontii Watson.
Blitum capitatum Linn.
Obione argentea Moq.
Eurotia lanata Moq.
†Alternanthera lanuginosa Torr.
Paronychia Jamesii T. & G.
Eriogonum alatum Torr.
" Jamesii Benth.
" umbellatum Torr.
" microthecum Nutt., var. effusum T. & G.
" annuum Nutt.
Oxyria digyna Camp.
Rumex salicifolius Weinm.
Polygonum ramosissimum Mx.
" tenue Mx.
" Pennsylvanica Linn.
" Bistorta Linn.
† " Persicaria Linn.
† " Hydropiper Linn.
† " acre H. B. K.
Arceuthobium americanum Nutt.
†Euphorbia hexagona Nutt.
" marginata, Pursh.
" montana Engelm.
† " heterophylla var. graminifolia.
* " dentata Mx.
* " humistrata Englm.
†Croton Texensis Müller.
* " capitatum Michx.
Urtica gracilis Aiton.
Parietaria Pennsylvanica Muhl.
Humulus Lupulus Linn.
Quercus undulata Torrey, var. Gunnisonii.
Betula occidentalis Hook.
†Celtis occidentalis Linn.
Salix longifolia Muhl., var. argyrophylla Nutt.
" cordata Muhl.
" desertorum Rich.
" *flavescens* Nutt. (?)
Populus tremuloides Mx.
" angustifolia James.
" *monilifera* Aiton.
Pinus contorta Dougl.
" ponderosa Dougl.
" flexilis James.
" aristata Engelm.
Abies Engelmanni Parry.
" Douglassii Lindl.
" *concolor* Lindl.
Juniperus virginiana L.
" *occidentalis* Hook.
Typha latifolia Linn.
Iris Missouriensis.
Sisyrinchium Bermudiana L.
Smilax herbacea Linn.
Streptopus amplexifolius D. C.
Calochortus Gunnisonii Watson.
Allium cernuum Roth.
" reticulatum Fraser.
Yucca angustifolia Pursh.
Juncus Balticus Deth., var. montanus Eng.
Tradescantia Virginica Linn.
†Cyperus Schweinitzii Torr.
Carex atrata Linn.
Lycurus phleoides H. B.
Sporobolus cryptandrus Gray.
Vilfa tricholepis Torr.
Muhlenbergia gracilis Trin.
" *glomerata* Trin.
" gracillima Torr.
Calamagrostis sylvatica D. C.
Stipa viridula Trin.
Bouteloua oligostachya Torr.
" hirsuta Lag.
" curtipendula Gray.
Munroa squarrosa Torr.
*Tricuspis purpurea Nutt.
Poa tenuifolia Nutt.
" andina Nutt.
*Eragrostis reptans Nees.
Festuca ovina L., var. brevifolia Watson.
Bromus Kalmii Gray.
Lepturus paniculatus Nutt.
Elymus Canadensis Linn.
" Sitanion Schult.
Cenchrus tribuloides Linn.
Andropogon furcatus Muhl.
Cheilanthes lanuginosa Nutt.
Woodsia scopulina Eaton.
Notholæna Fendleri Kunze.
Selaginella rupestris Spring., var tropica.

Cnicus edulus Nutt. (?). A single plant collected near Veta Pass; whilst agreeing tolerably well with the description of this species, the specimen is not in a condition to be satisfactorily determined. T. Meehan, who collected it, says he has not seen this plant from Colorado before.

Troximon glaucum. On the roadside between Bellevue mountain and Central City; quite scarce.

Phacelia glandulosa Nutt. Southern Colorado.

Physalis hederæfolia Gray (?). On the plains before reaching Denver; plant prostrate and very viscid, leaves small and short petioled.

Mimulus floribundus Dougl. The specimens collected at Boulder Falls have all the pedicels shorter than the leaves.

Herpestis rotundifolia Pursh. Collected at Cahokia, Illinois; with the leaves having punctate dots.

Salix flavescens Nutt. (?) On the trail to Pike's Peak through Engelmann's Cañon. M. S. Bebb says: " It has been frequently collected and is most likely allied to *S. flavescens* Nutt. of the Pacific coast, somewhat as *S. Fendleriana* is allied to *S. lasiandra*, that is, it may prove a hybrid between that and *S. discolor*."

Populus monilifera Aiton. On the low lands near Pueblo.

Abies concolor Lindley and *Juniperus occidentalis* Hook. In Engelmann's Cañon and Queens Cañon.

Smilax herbacea Linn. Plant more robust than the eastern form, leaves larger, more rounded; one specimen, only, collected in Glen Eyrie, with no evidence of the odor that usually accompanies the plant.

Lycurus phleoides H. & B. Collected in the Garden of the Gods, probably introduced from Mexico by traveling teamsters.

Muhlenbergia glomerata Trin. A form of this species near Manitou, not common.

——:o:——

MOLD AS AN INSECT DESTROYER.

BY C. G. SIEWERS.

THE perplexing problem: How shall we check the excessive increase of noxious insects that imperil our crops? has been put in a fair way of solution by the researches of Dr. Bain, a Prussian savant, as recorded by Dr. Hagen, of Cambridge, Mass., in the June number of the *Canadian Entomologist*.

down, or fearfully lopped of their branches to abate the nuisance. They attacked the silver poplar in preference to all others, a tree singularly free from caterpillars heretofore. I found a small tree in my yard badly infested, and promised two small boys one cent a nest for all they got down with not less than twenty-five in a brood, and burning them as they were brought me, paid them ninety-seven cents for their hour's work. What was to be expected the next year but the total ruin of every shade tree; but my payment to the same boys was but forty cents, and the next year not one was to be found, and they have never returned to vex us. Continuous wet and cloudy weather may be sufficient to infect with fungus the food these caterpillars eat, but wherever we turn our eyes we find the provisions of nature ample to repress surplus life on this globe, and in no case more so than in our own species, where the half that survive infancy are winnowed out by sword, pestilence and famine, till but a corporal's guard can be rallied at our allotted term of three score years and ten. The cases I have described are by internal poisoning; I will add one where the poison fungus acted externally. My first attempt to carry through the winter that hybernating larva, the black bear (*Expanthcrea*), proved a total failure, as I put them away in the cellar where they were attacked and covered with mold, and though I washed and brushed them apparently clean, dried them in the sun and kept them out of doors the rest of the winter, they all died in the spring, refusing all food. Put away the next winter in leaves and brush, in the open air, I lost but one in ten. Exposed all winter to snow, frost and rain, under chips and wet leaves, coming out in the spring to feed, distended with moisture, they are perfectly healthy, for no fungus spores have been able to fasten upon them. That prolific oak larva, *Anisota senatoria*, is also a badly infected species, which makes it rather lucky for oak trees, for but few of them ever come to maturity. Experiments with diluted yeast should be tried on the potato bug, tobacco, army and cotton worm, and on the grasshoppers of old pastures and clover fields. The proper policy is not to kill, but simply to infect them that they may disseminate the poison. But while we fill the air with fungus spores let us have a care to discriminate between the just and the unjust; in slaughtering the Colorado bug and grasshopper, let us not also lay violent hands on our honey bee, on our harmless and beautiful butterflies, and on the various insects that sport in the sun and enliven the face of nature. The bugs and the worms that annoy us can easily be kept in check as I have shown, by paid handpickers.

When Pasteur, employed by the French government to investigate the fatal malady that had attacked the silk-worm, made the discovery that the disease was caused by a fungus growth which he styled muscardine, that it could be imparted to healthy larvæ simply by crushing infected ones on their food, and that the disease could be detected, by means of a lens, in the egg itself, and thus the good eggs separated from the bad, he saved from utter ruin thousands of French families whose main support depended on this industry. But he did more. Though he carried his researches no farther, others took up the investigation where he abandoned it, and the result of Dr. Bain's experiments, continued for twelve years, seem to have established the following facts:

That the mold of the mash tub, known as yeast, the mold that infects flies and fastens them to our walls and windows, the common mold of cellars and damp places, and the mold that attacks certain water plants are but different developments of allied species of fungi, and alike fatal to certain species of insects that are brought into contact with it; and that the disease was developed in France by moist food, lack of ventilation and cleanliness, is probable, and though many were able to pass through all stages, their infected eggs spread the disease through the land, and in this way became epidemic.

I have just had an unpleasant experience of the effect of mold in the loss of a full-grown imperial walnut larva that I had reared from its first molt. Its food was inserted in wet sand in a covered tub, and before I was aware, its droppings and food were covered with mold. Fresh food, a sun bath and change of quarters was of no avail; it refused food for four days, then dropped from its perch a moist discolored mass. In an article in the *Canadian Entomologist* (1877), I gave an account of a large colony of Callimorpha larvæ, a species by no means common generally, and of my failure to bring one larva in two hundr[illegible] the pu[illegible] state. They were all taken at maturity, like t[illegible] worms, with a purging of whitish serum. Th[illegible] they fed in the woods were also covered [illegible] The next year they were as rare as ev[illegible] the shade trees of our town, Nev[illegible] legions of small gray caterpillars [illegible] foliage, and invading doorway[illegible] broom was in constant requ[illegible]

Cercocarpus parvifolius Nutt.
Geum Rossi Seringe.
Fragaria vesca Linn.
Potentilla glandulosa Lindl.
" rivalis, Nutt.
" dissecta Pursh.
" fruticosa Linn.
" Anserina Linn.
*Rosa setigera Mich.
" blanda, Aiton, var. setigera Crépin.
Cratægus coccinea L. var.
Saxifraga bronchialis Linn.
" nivalis Linn.
" Jamesii Torrey.
" *chrysantha* Gray.
Jamesia americana T. & G.
Sedum Rhodiola D. C.
" stenopetalum Pursh.
Epilobium angustifolium Linn.
" paniculatum Linn.
Gayophytum ramosissimum T. & G.
†Œnothera coronopifolia T. & G.
†Gaura parviflora Dougl.
† " biennis Linn.
*Ludwigia polycarpa S. & P.
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Mentzelia nuda T. & G.
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Ligusticum scopulorum Gray.
Symphoricarpus montanus H. B. K.
" occidentalis R. Br.
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Townsendia eximia Gray.
*Boltonia glastifolia L'Her.
Aster lævis Linn.
" multiflorus Aiton.
" falcatus Lindl.
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" " var. multiradiata T. & G.
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Aplopappus spinulosus D. C.
" pygmæus Gray.
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Grindelia squarrosa Dunal.
Chrysopsis villosa Nutt.
" " var. hispida.
Pericome caudata Gray.
*Iva ciliata Willd.
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*Ambrosia psilostachya D. C.
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Rudbeckia hirta Linn.
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* " rigidus Desf.
" pumilis Nutt.
" *Maximiliana* Schrad.
Heliomeris multiflora Nutt.
*Coreopsis aristosa Mx., var. mutica.
Ximenesia encelioides Cav.
Dysodia chrysanthemoides Lag.
Gaillardia aristata Pursh.
Actinella grandiflora T. & G.

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Plantago patagonica var. aristata Gray.
Mirabilis multiflora Gray.
" oxybaphoides.
*Oxybaphus nyctagineus Sweet.
" angustifolius Sweet.
Abronia fragrans Nutt.
Chenopodium Fremontii Watson.
Blitum capitatum Linn.
Obione argentea Moq.
Eurotia lanata Moq.
†Alternanthera lanuginosa Torr.
Paronychia Jamesii T. & G.
Eriogonum alatum Torr.
" Jamesii Benth.
" umbellatum Torr.
" microthecum Nutt., var. effusum T. & G.
" annuum Nutt.
Oxyria digyna Camp.
Rumex salicifolius Weinm.
Polygonum ramosissimum Mx.
" tenue Mx.
" Pennsylvanica Linn.
" Bistorta Linn.
† " Persicaria Linn.
† " Hydropiper Linn.
† " acre H. B. K.
Arceuthobium americanum Nutt.
†Euphorbia hexagona Nutt.
" marginata, Pursh.
" montana Engelm.
† " heterophylla var. graminifolia.
* " dentata Mx.
* " humistrata Englm.
†Croton Texensis Müller.
* " capitatum Michx.
Urtica gracilis Aiton.
Parietaria Pennsylvanica Muhl.
Humulus Lupulus Linn.
Quercus undulata Torrey, var. Gunnisonii.
Betula occidentalis Hook.
†Celtis occidentalis Linn.
Salix longifolia Muhl., var. argyrophylla Nutt.
" cordata Muhl.
" desertorum Rich.
" *flavescens* Nutt. (?)
Populus tremuloides Mx.
" angustifolia James.
" *monilifera* Aiton.
Pinus contorta Dougl.
" ponderosa Dougl.
" flexilis James.
" aristata Engelm.
Abies Engelmanni Parry.
" Douglassii Lindl.
" *concolor* Lindl.
Juniperus virginiana L.
" *occidentalis* Hook.
Typha latifolia Linn.
Iris Missouriensis.
Sisyrinchium Bermudiana L.
Smilax herbacea Linn.
Streptopus amplexifolius D. C.
Calochortus Gunnisonii Watson.
Allium cernuum Roth.
" reticulatum Fraser.
Yucca angustifolia Pursh.
Juncus Balticus Deth., var. montanus Eng.
Tradescantia Virginica Linn.
†Cyperus Schweinitzii Torr.
Carex atrata Linn.
Lycurus phleoides H. B.
Sporobolus cryptandrus Gray.
Vilfa tricholepis Torr.
Muhlenbergia gracilis Trin.
" *glomerata* Trin.
" gracillima Torr.
Calamagrostis sylvatica D. C.
Stipa viridula Trin.
Bouteloua oligostachya Torr.
" hirsuta Lag.
" curtipendula Gray.
Munroa squarrosa Torr.
*Tricuspis purpurea Nutt.
Poa tenuifolia Nutt.
" andina Nutt.
*Eragrostis reptans Nees.
Festuca ovina L., var. brevifolia Watson.
Bromus Kalmii Gray.
Lepturus paniculatus Nutt.
Elymus Canadensis Linn.
" Sitanion Schult.
Cenchrus tribuloides Linn.
Andropogon furcatus Muhl.
Cheilanthes lanuginosa Nutt.
Woodsia scopulina Eaton.
Notholæna Fendleri Kunze.
Selaginella rupestris Spring., var tropica.

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Cnicus edulus Nutt. (?). A single plant collected near Veta Pass; whilst agreeing tolerably well with the description of this species, the specimen is not in a condition to be satisfactorily determined. T. Meehan, who collected it, says he has not seen this plant from Colorado before.

Troximon glaucum. On the roadside between Bellevue mountain and Central City; quite scarce.

Phacelia glandulosa Nutt. Southern Colorado.

Physalis hederæfolia Gray (?). On the plains before reaching Denver; plant prostrate and very viscid, leaves small and short petioled.

Mimulus floribundus Dougl. The specimens collected at Boulder Falls have all the pedicels shorter than the leaves.

Herpestis rotundifolia Pursh. Collected at Cahokia, Illinois; with the leaves having punctate dots.

Salix flavescens Nutt. (?) On the trail to Pike's Peak through Engelmann's Cañon. M. S. Bebb says: "It has been frequently collected and is most likely allied to *S. flavescens* Nutt. of the Pacific coast, somewhat as *S. Fendleriana* is allied to *S. lasiandra*, that is, it may prove a hybrid between that and *S. discolor*."

Populus monilifera Aiton. On the low lands near Pueblo.

Abies concolor Lindley and *Juniperus occidentalis* Hook. In Engelmann's Cañon and Queens Cañon.

Smilax herbacea Linn. Plant more robust than the eastern form, leaves larger, more rounded; one specimen, only, collected in Glen Eyrie, with no evidence of the odor that usually accompanies the plant.

Lycurus phleoides H. & B. Collected in the Garden of the Gods, probably introduced from Mexico by traveling teamsters.

Muhlenbergia glomerata Trin. A form of this species near Manitou, not common.

——:o:——

MOLD AS AN INSECT DESTROYER.

BY C. G. SIEWERS.

THE perplexing problem: How shall we check the excessive increase of noxious insects that imperil our crops? has been put in a fair way of solution by the researches of Dr. Bain, a Prussian savant, as recorded by Dr. Hagen, of Cambridge, Mass., in the June number of the *Canadian Entomologist*.

When Pasteur, employed by the French government to investigate the fatal malady that had attacked the silk-worm, made the discovery that the disease was caused by a fungus growth which he styled muscardine, that it could be imparted to healthy larvæ simply by crushing infected ones on their food, and that the disease could be detected, by means of a lens, in the egg itself, and thus the good eggs separated from the bad, he saved from utter ruin thousands of French families whose main support depended on this industry. But he did more. Though he carried his researches no farther, others took up the investigation where he abandoned it, and the result of Dr. Bain's experiments, continued for twelve years, seem to have established the following facts:

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down, or fearfully lopped of their branches to abate the nuisance. They attacked the silver poplar in preference to all others, a tree singularly free from caterpillars heretofore. I found a small tree in my yard badly infested, and promised two smail boys one cent a nest for all they got down with not less than twenty-five in a brood, and burning them as they were brought me, paid them ninety-seven cents for their hour's work. What was to be expected the next year but the total ruin of every shade tree; but my payment to the same boys was but forty cents, and the next year not one was to be found, and they have never returned to vex us. Continuous wet and cloudy weather may be sufficient to infect with fungus the food these caterpillars eat, but wherever we turn our eyes we find the provisions of nature ample to repress surplus life on this globe, and in no case more so than in our own species, where the half that survive infancy are winnowed out by sword, pestilence and famine, till but a corporal's guard can be rallied at our allotted term of three score years and ten. The cases I have described are by internal poisoning; I will add one where the poison fungus acted externally. My first attempt to carry through the winter that hybernating larva, the black bear (*Expanthcrea*), proved a total failure, as I put them away in the cellar where they were attacked and covered with mold, and though I washed and brushed them apparently clean, dried them in the sun and kept them out of doors the rest of the winter, they all died in the spring, refusing all food. Put away the next winter in leaves and brush, in the open air, I lost but one in ten. Exposed all winter to snow, frost and rain, under chips and wet leaves, coming out in the spring to feed, distended with moisture, they are perfectly healthy, for no fungus spores have been able to fasten upon them. That prolific oak larva, *Anisota senatoria*, is also a badly infected species, which makes it rather lucky for oak trees, for but few of them ever come to maturity. Experiments with diluted yeast should be tried on the potato bug, tobacco, army and cotton worm, and on the grasshoppers of old pastures and clover fields. The proper policy is not to kill, but simply to infect them that they may disseminate the poison. But while we fill the air with fungus spores let us have a care to discriminate between the just and the unjust; in slaughtering the Colorado bug and grasshopper, let us not also lay violent hands on our honey bee, on our harmless and beautiful butterflies, and on the various insects that sport in the sun and enliven the face of nature. The bugs and the worms that annoy us can easily be kept in check as I have shown, by paid handpickers.

NOTES ON PACIFIC COAST FISHES AND FISHERIES.

BY W. N. LOCKINGTON.

IN the market of San Francisco there was recently a specimen of *Poronotus simillimus* (the pompino of this coast) that had two mouths, one below the other, both furnished with teeth, and in size and external appearance the exact counterparts of each other. The lower mouth was situated somewhat behind the upper or normal mouth, directly beneath the eye and in front of the interoperculum. I much regret that I was unable to obtain possession of the fish, which is now, I believe, preserved in alcohol by the watchman of the market. I cannot, therefore, say anything about the bony structure of the extra mouth, or about the peculiarities of the digestive canal.

Anarrhichthys felis Grd., has, during the summer months, been frequently brought to the market of San Francisco, where it is sold as "eel," a name which is here applied to all the Blennioid fishes, as well as to *Leurynnis paucidens* and *Ophidium taylori*. Some of the dealers and fishermen, however, have given it the more appropriate name of "wolf-eel." The individuals brought to market are usually from four to five feet in length, but the species attains much larger dimensions. A specimen sent to the California Academy of Sciences, by Capt. Lawson, of the Coast Survey, and unfortunately lost through the lack of means to preserve it, measured eight feet in length; and one seven feet in length was noticed in the daily papers about three years since as an "infant sea-serpent." One large individual that lay upon the stall recently, showed the effects of a battle in the want of all that portion of the body situated posterior to the anus. The stomach of a very stout-looking example, five feet long, was opened, and was found to be filled with the tests of *Echinarachnius excentricus*, the common cake-urchin of the coast, broken into large fragments, many of them considerably more than an inch across; this Echinoderm is extremely abundant on the bar of San Francisco harbor at a depth of about seven fathoms, and the denuded tests are among the common objects of the seashore at the Cliff House.

The shark described by Ayres under the name of *Notorhynchus maculatus*, included by Günther under *Notidanus indicus*, and called by Gill (Proc. Acad. Nat. Sciences, Phila., 1864, 150) *Notorhynchus borealis*, attains considerable dimensions. An indi-

vidual taken at Long wharf, inside the harbor of San Francisco, about five years since, measures seven feet nine inches in total length.

The chimæra, *Hydrolagus colliei*, is tolerably common on the more northern parts of the Pacific coast of North America. Mr. Ivan Petroff, editor of the *Alaska Appeal*, asserts that a Chimæra which he saw and of which he made a rough sketch (which he showed me), was without the long caudal filament of *H. colliei*, and had a simple forked tail. Is it possible that there are two species of Chimæra in the North Pacific? The specimen just mentioned was taken while fishing for halibut and cod, and its stomach was filled with broken shells. I do not believe that anything is on record which tends to prove the use, in the economy of the Chimæra, of the curious projection upon the nose, armed at the end with a close-set array of hooked teeth set upon a terminal button of cartilage. The action of the individual in question, which saluted the cabin-boy who hauled it up by taking a piece out of his finger with this appendage, tends to prove that it is a weapon of offence.

The sea-basse (*Atractoscion nobilis* Gill) is one of the most highly prized of the fishes of our markets, so much so that its name is given to the flesh of other species. Thus sturgeon is usually sold in the restaurants under the name of "sea-basse," and that curious dish called "tenderloin of sole" is sturgeon again. The sea-basse is unfortunately not sufficiently abundant to supply the demand for it, and is sometimes absent from the markets for months together. It attains a considerable size, examples of from fifty to sixty pounds occur not infrequently, and individuals weighing seventy-five or even ninety-eight pounds have been brought to market. This species and *Genyanemus lineatus* are the only Sciænidæ sufficiently abundant in our markets to be of importance as articles of food.

I have not yet been able to prove whether the cod of the Pacific Coast Cod-fishery is *Gadus auratus* Cope, or *G. macrocephalus*, as at present I have only seen the dried and beheaded examples prepared for market. Appleton's Cyclopædia gives the quantity of cod-fish taken in 1870, in Alaskan waters, at 94,750 quintals; whereas the total catch of last year amounted only to about 1500 tons, or less than one-third of the former amount. This would appear to indicate a great falling off in the quantity

of fish taken, but I can scarcely believe that this offers a sufficient explanation, as, although it appears that the trade was scarcely as extensive last year as in previous years, the dealers do not speak of any considerable diminution. It appears more probable that, as all the species of *Sebastes* (*Sebastichthys*, *Sebastomus*, *Sebastosomus*, and *Sebastodes* of Gill) are commonly called rock-cod, and the large green *Ophiodon elongatus* is known as "cod," that the quantities of these fishes brought fresh to market are, in the figures given in the Cyclopædia, included along with that of the true Gadus. The dried fish has about fourteen rays in the first, fourteen in the second and seventeen in the third dorsal; with nineteen in the first, and the same number in the second anal. The first dorsal is highest, the third shortest, and the base of the second anal is shorter than that of the first. The fishery is conducted in much the same manner as that of the Atlantic; the fish are taken by trawls in shallow water, by angle-lines in deep water, and are headed, split, cleaned and salted on board ship. The drying, however, is not done on the spot but is deferred until after arrival at San Francisco. Two large establishments for drying the fish are situated within ten miles of that city, and at one of them, at least, the fish are not dried in piles, but are kept in strong red-wood tanks framed together without nails, and dried as required by the market, which is principally local. A few of the fish are, however, exported to the Pacific shore of South America and to Australia.

The angle-line is almost exclusively used in the Sea of Okkotsk, where rather the larger part of the fish are taken, partly on account of the depth of the water, but partly because of the abundance, on the sand-banks, of a small Crustacean, called by the fishermen a "sand-flea," which attacks and devours the fish upon the trawl-line before it can be drawn. The species of Orchestia and its allied genera, as well as those of Hippa, are commonly called sand-fleas on this coast.

As has been remarked on the Atlantic coast, the fish are of better quality in deep water than on the more accessible banks, but as yet the fishery is entirely carried on in what would be called shallow water in the Atlantic. In the Sea of Okkotsk forty to fifty fathoms is about the usual depth, while at the Shumagin islands, the principal fishing locality on the Alaskan coast, ten to fifteen fathoms is the usual depth. The trawls used in the

Alaska cod-fishery are often six hundred fathoms or three thousand feet long, and bear on each side a row of hooks at every half fathom, or thereabouts. The dried fish are sorted into three sizes, the largest are put up in wooden cases, the next size in bundles, while the small fishes are divested of their skin, vertebræ and fins, cut in halves, and packed in cases under the name of "boneless cod-fish." The fishery is about fifteen years old, and at this time about thirteen vessels are engaged in it; the smaller fore-and-aft rigged vessels are principally used in Alaskan waters, while the larger square-rigged vessels run to the Sea of Okkotsk. The schooners employed at the Sheumagin islands often make two or three trips in the season. About two hundred and fifty hands are usually employed by this industry. The fishermen are paid a fixed sum per thousand fish. At Kadak natives are engaged to head, split and salt the fish, earning from seventy-five cents to one dollar per day. A few years ago the dried fish were worth nine cents per pound, but at the present time the best quality is worth only four cents.

The Alaska cod-fish is first met with in Puget sound and its vicinity, but becomes more abundant farther north. Although the principal fishing grounds are the Sea of Okkotsk and the Sheumagin islands, extensive banks exist elsewhere, and local fisheries are carried on at various points in Vancouver island, British Columbia, and along the coast of Alaska, as, for example, at Wrangel. Neither the oil from the livers, the sounds or the tongues are at present utilized. In the stomachs of those opened, various kinds of small fish and squids are stated to have been found. The fishery is at present only in its infancy, its limited extent is not in any way due to the scarcity of the fish but to the struggle that has to be maintained with the eastern article, which has so far successfully excluded the Pacific fish from the regions east of the Sierras.

The same may be said of the halibut fishery. The fish is abundant in the northern waters and attains a large size, but though small quantities have been smoked and canned, the article cannot successfully compete, even in California, with that from the Atlantic.

THE FERTILIZATION OF OUR NATIVE SPECIES OF CLITORIA AND CENTROSEMA.

BY WILLIAM TRELEASE.

A VISITOR to the Southern States in the early summer will notice among the most conspicuous flowers of dry, open wood-borders and fields, the two related leguminous species known to botanists as *Clitoria mariana* and *Centrosema virginiana*; the former a low vine, sometimes twining for a few feet up some supporting shrub; the latter a strong, slender twiner, not infrequently ascending to the height of ten or more feet. In accordance with its small size, the former has, as a rule, but one or two flowers expanded at a time, and they are of a pale purple, so that it is far outshone by its relative, whose entire length is often covered by bright purple flowers—not quite so large, to be sure, as those of Clitoria, but compensating for diminished size by increased number and depth of color—hence a shrub covered by this vine in full bloom is often an object of great beauty.

If we examine a flower of either species we find that its vexillum or standard (*s*, Fig. 1) is the lowest petal, while in most leguminous plants it is the uppermost when the flower is in the position which it naturally occupies on the plant; and this position allows it to serve in the species under consideration as an alighting place for insects.

An examination of the flower of Clitoria will show that the lateral borders of the horizontal standard are folded upwards to form a trough, this structure forcing insects to enter the flower on the median line and leading them directly beneath the keel (*k*). The uniform pale-purple color of the rest of the corolla is deviated from in this trough by the production of special guiding marks, which combine with the curvature of the standard to lead all insects into the flower in a constant direction. These marks consist of a yellowish spot near the apex of the standard, which narrows into a line following the middle line of the petal. From the base of this line radiate dark-purple lines on each side, their widest divergence being just below the widest part of the yellow line. The wing petals (*w*) are coherent with the keel at the point *p*, and beyond this point they diverge somewhat, thus aiding in a slight degree the upturned borders of the standard. The keel is split on its lower border, but when undisturbed the edges are

closely applied to each other. The filaments (*f*) are united, excepting on the side next the vexillum. Within the base of the filaments is a large nectar gland (*n*), broken on the side next the standard, and slightly five-lobed on its free surface, suggesting its homology with a whorl of five stamens. Through the break on its lower side and the breaks in the tube formed by the filaments, the abundantly-secreted nectar flows into the basal part of the standard, and it is to this that the guiding marks of this petal lead. The pistil consists of an elongated, stalked ovary (*o*) and a slender style terminated by an enlarged stigma (*st*), which usually protrudes slightly from the tip of the keel when the flower is expanded.

From its structure it may be predicted that this flower is designed to be fertilized by bees, but though I have often carefully watched dozens of plants growing together, for a long time, I have never seen a bee visit one of them, though I have sometimes noticed a swiftly-flying black bee (*Melissodes nigra*) flying nervously among the flowers, and I have no doubt that this species, at least, visits them for their honey. Once I saw a butterfly (*Callidryas eubule*) standing on the keel and having its proboscis inserted between the bases of the keel and the wing petals, thus reaching the nectar at the base of the standard. To show what would happen if a bee entered the flower, we may insert the end of a small pencil between the vexillum and the tip of the keel. First of all this comes in contact with the stigma, and this would take up any pollen on its upper surface. Differently from what occurs in the majority of leguminous flowers, the rigid keel and standard do not readily move apart by a wedging action between them, but as we insert the pencil a little farther it encounters the wings on either hand and forces these apart laterally. In doing this the sides of the keel are slightly pulled apart, owing to their union with the wings, and the pollen collected in the keel is allowed to fall upon the pencil. That this is what occurs in nature when a bee visits the flower, I think there can be little doubt; though a set of collecting hairs (Fig. IV, *h*) on the inner side of the style makes it appear probable that the keel is forced somewhat upward, so as to cause these to pump out a quantity of pollen. In Central Alabama, where these observations were made, a fair percentage of the flowers set fruit, but I am unable to say whether the plant is self-fertile or not.

In Centrosema the standard is either horizontal or considerably inclined, being nearly vertical in some cases; it is more nearly flat than in Clitoria, and its lateral margins are usually more or less noticeably bent downward. Near its base, on the middle

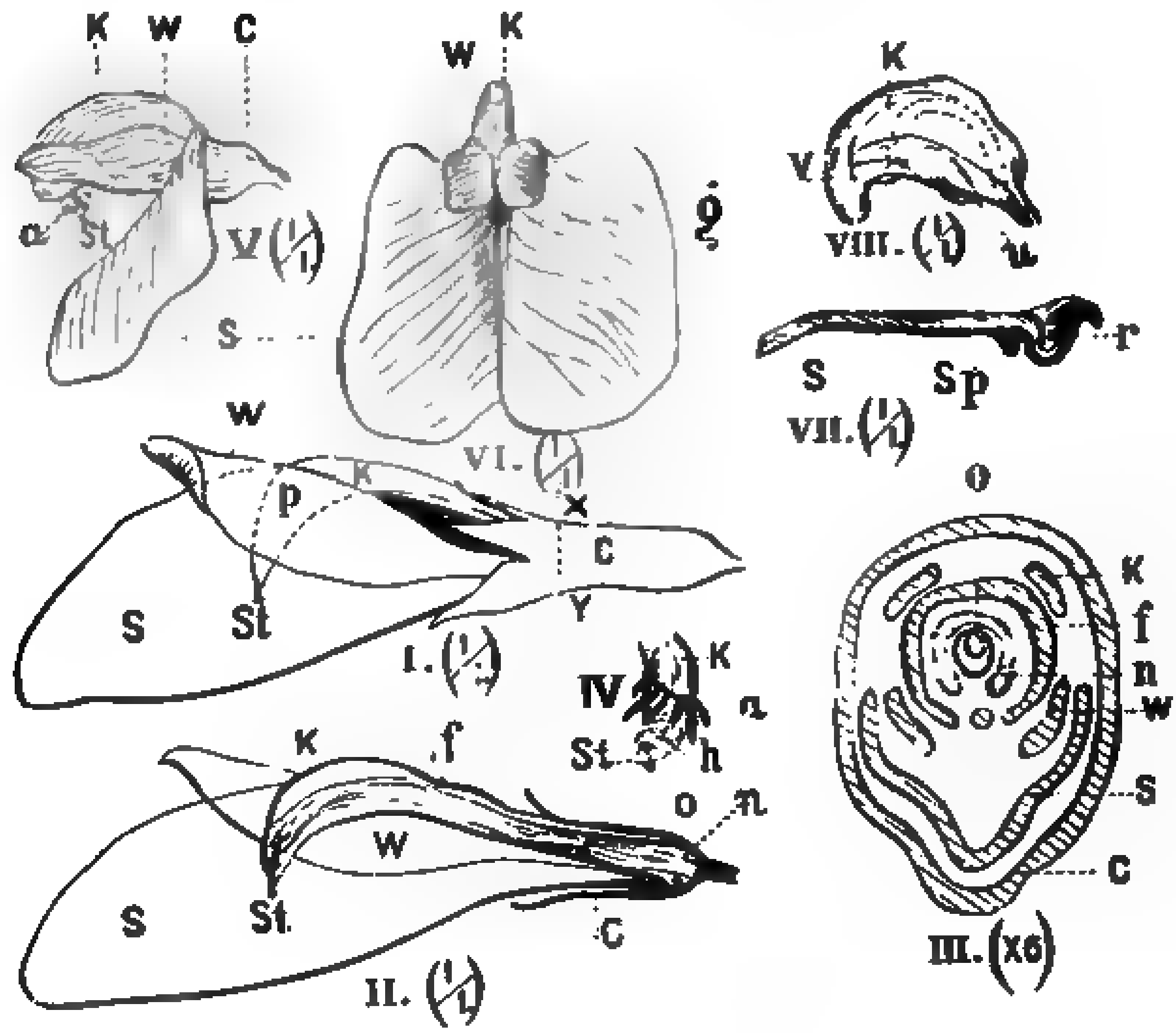

FIG. I.—Flower of *Clitoria mariana*, with nearer half of vexillum removed, natural size.

FIG. II.—The same with the nearer wing and the nearer keel petal removed, as well as a part of the staminal tube and the nearer half of the calyx.

FIG. III.—Cross section (diagrammatic) of Fig. I at *xy*.

FIG. IV.—Tip of the keel with the stamens and pistil unnaturally protruded, enlarged.

FIG. V.—Flower of *Centrosema virginiana* seen from the side, natural size. The keel is bent so as to expose the anthers and stigma.

FIG. VI.—The same from in front.

FIG. VII.—Vexillum of Fig. VI in longitudinal section, natural size.

FIG. VIII.—Keel after removal of the wings and standard, natural size. The dotted line indicates the position of the stamen and pistil.

In all of the figures *a* indicates the anthers; *c*, the calyx; *f*, the filaments; *g*, the guiding groove; *h*, the collecting hairs; *k*, the keel; *n*, the nectar-gland; *p*, the point of union of keel and wings; *r*, the nectar reservoir; *s*, the standard or vexillum; *st*, the stigma; *u*, part of the spring for retaining the keel in its normal position; *v*, the pouch for the stigma and anthers; *w*, the wings; *xy*, the point at which the section, Fig. III, is taken.

line, this petal has a guiding groove (*g*) of considerable depth, which connects with a slight cup (*r*) at the very base, this cup serving as a receptacle for nectar. On its lower surface, just in front of this receptacle, the vexillum is provided with a solid spur (*sp*, Fig. VII), which forms one character by which this genus is distinguished from Clitoria, but which seems to perform no function now. On the upper surface of the standard a white line, bordered on each side by fine lines of dark purple, runs from the basal guiding groove nearly to the apex of the petal, while others radiate from it on either hand, following the general direction of the veins of the standard. These marks, like those of the species last discussed, serve as guides to the nectar, which is poured into its receptacle, from a vaguely nine to ten-lobed annular gland, through the split in the staminal tube. The wings are coherent with the keel, are laterally inflated, and are so arranged as to prevent anything larger than the proboscis of a butterfly from reaching the nectar of the flower excepting by way of the guiding groove. The keel petals are grown together along both edges with the exception of a small space at their base and another at their apex. On the border next the vexillum, at about one-third the distance from its base to its apex, each keel-petal bulges outward to form an egg-shaped, thin-walled protuberance (Fig. VIII, *u*), the two being approximated on the median line. Half way between this and the tip, another common inflation (*v*) forms a closed pouch in which the stigma and anthers commonly lie, the style and stamens being strongly curved.

In reaching its head under the keel for the purpose of protruding its tongue into the nectar receptacle, through the guiding groove, a bee encounters the first-mentioned protrusion, which, with the inflated sides of the keel and the wings, acts as a spring, keeping the keel in its normal position, with the stigma and anthers concealed within it, in their pouch. But when this protruding pouch is pressed from below it bends the keel on its back and forces it slightly backward at its base, so that the stigma and anthers—which move but little—are protruded from the split apex of the keel and come in contact with the back of the bee. After the pressure is removed the elasticity of the parts returns them to their former position.

In spite of the guiding marks some insects fail to find the nectar. For example, one day in August an ichneumon-fly was seen

to try anxiously to find access to the honey of several flowers, but in every case it tried to enter at the side of the wings, and always failed. One large butterfly was seen to insert its proboscis at the side of the wings, and as it remained quietly standing for some time it probably obtained nectar. Several small butterflies alighted on the vexillum and ran their proboscides down the guiding groove, but necessarily failed to fertilize the flowers as they exerted no pressure on the keel. Many humble bees were seen to enter the flowers. Catching their anterior tarsi on the sides of the standard, they pulled themselves between this and the keel by sheer force, and then relaxing their hold, they protruded their tongues and feasted upon the nectar. In every case they caused the stigma and anthers to be exserted, and these always came in contact with their backs. Where flowers had been visited many times by these bees the sides of the vexillum, and especially near its base, were greatly scratched, and in some cases cut through by their sharp tarsal claws. When the bee left the flower the keel invariably returned to its former position so as to enclose the organs of fertilization. Hive bees were also seen to visit flowers of this species several times, and they acted precisely as the humble bees did, and with a similar result.

Quite a number of flowers were seen with large perforations (Fig. VIII) through both wing and keel, just back of the position commonly occupied by the anthers and stigma. As these did not allow access to the nectar, but did expose the pollen, I am inclined to think that they were made by some pollen-collecting insect—probably humble bees—though I was unable to see the openings made or used by any insect. In Alabama, where these observations were made, the flowers of this plant are largely fertile, but it was not determined whether they are self-fertile or not.

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RECENT LITERATURE.

CLARK'S ANATOMY AND PHYSIOLOGY OF THE LUCERNARIÆ.[1]—American zoölogical science has, from the beginning, been especially lacking in histological investigations. The lamented author of the beautiful memoir before us, did far more than any one

[1] *Lucernariæ and their Allies.* A memoir on the anatomy and physiology of *Haliclystus auricula* and other Lucernarians, with a discussion of their relations to other Acalephæ, to Beroids and Polypi. By HENRY JAMES CLARK, B.S., A.B. Smithsonian Contributions to Knowledge. Washington, September, 1878. 4to, pp. 130, 11 plates.

else to remove this reproach upon American biology. He was admirably adapted by nature for doing histological work, being cautious, careful, thorough and honest, and skillful in the technical and mechanical part of the work. But the present memoir, as well as many of Clark's other writings, evinces a thoughtfulness and grasp of the subject which characterizes observers of a high order, though he failed at times to record his observations in a style as terse and simple as that of some other writers.

Though this monograph bears as its date of publication, September, 1878, five years after the author's death, we received it in July of the present year. If we are to judge by the quality of the memoir, it is the most important zoölogical work (because involving so much hard labor and done with so much care) which has appeared in this country for several years, and we say this without disparagement to others.

The Lucernaria is a creature, not often met with, living attached by its tail or peduncle to eel grass or sea weeds just beyond low-water mark. The differences of opinion regarding its true position in nature, whether to be reckoned a jelly-fish or a type of a distinct order, led the author, who had paid so much attention to the Polyps and Acalephs, to devote time extending over several years to the full elaboration of its general and minute anatomy, its mode of development and relations to neighboring types of life. This has led to the preparation of an elaborate monograph, most carefully prepared, and illustrated by drawings which are not inferior in faithfulness, finish and artistic effect to those of any American, and few European delineators of the invertebrate animals. The text is divided into seven chapters; in the first, on individuality, the author discusses the subject of animal individuality, illustrating his points by reference mainly to the polyps and acalephs. The subject is sufficiently simple when the vertebrates are involved, but among the polyps, jelly-fishes, Polyzoa and Ascidians, where many forms are social, compound and often many-headed, it is difficult to say where the organ ends and the individual begins. The author clearly distinguishes between organs like those of the Tubularians and Siphonophores which have a high degree of individuality, and the individual joints (proglottides) of the tape worms; and does not fall into the error of regarding the former as truly individuals. The sexual and sexless organs of the polycephalic Acalephs, such as the Tubularians, "are necessary to make up a complete organism, *i. e.*, vegetative and reproductive, the one a complement of the other, neither *alone* can represent the *individual* unit, or whole cycle of life." We infer from the statement made that Clark regarded the so-called polymorphic individuals as "organs under various disguises;" a view which seems to us most reasonable. Clark ascribes a high degree of individuality to the jelly-fish, Pelagia, and only a less amount to Lucernaria.

The author in a third chapter attempts to point out an antero-posterior repetition of parts in the strobila of the Acalephs. In the fourth and fifth chapters a detailed account of the anatomy and physiology of Lucernaria is given. A number of new terms are adopted; among them *opsophragma* for the face-wall of Lucernaria, and *ectophragma* for the wall of the posterior face; *opsomyoplax* for the stratum of muscular substance immediately subtending the opsophragma. The bulk of the solid material of the body or musculo-gelatiniform layer is called the *chondromyoplax* (this is probably the mesoderm of recent writers); the gelatiniform layer is designated as the *chondrophys.* Particular attention is paid to the taxonomy of the tentacles, so characteristic a feature of these animals; and the fine structure of the marginal adhesive bodies (Colletocystophores) or anchors, is elaborated, and these bodies judged to be modified tentacles; certain other bodies (digituli) are carefully discussed and compared with similar bodies in the Acalephs. The digestive, nervous and reproductive systems are described, and then follows Chapter VI on embryology, comprising a description of the smallest specimen of *Halyclystus auricula* yet met with, which was one-sixteenth of an inch in diameter; but the development within the egg is not given. In the chapter on histology a discussion as to the nature of cells is introduced in a lengthy foot-note. Clark believed with other advanced histologists that "*cells* so called (no matter whether constituted according to the older histologists or according to the most recent theory), are, after all, of secondary importance, and that the *cytoblastema* (which we do not distinguish from intercellular substance) is in the main an *essential element*, the potential progenitor of all tissues, and that it projects itself into the utmost future of the living body by a process of self-proliferation." This cytoblastema, as Schwann (not Schwa*m*, as printed in this memoir) called it, corresponds to the sarcode of Dujardin or protoplasm of recent authors, as he remarks incidentally that "all Rhizopods are moving, sentient masses of *Cytoblastema*, and that alone."

It is now generally believed, and has especially been insisted on by Hæckel that cilia are prolongations or extensions of the protoplasmic substance of the cells from which they arise. This discovery was first made by Clark and published by him as early as 1863. He then stated that "all vibratile cilia originate in the amorphous intercellular substance."[1] He then adds in the present memoir, which was written in 1869 and 1870, judging by the context: "This has particular reference to those cilia that cover cells which are fully developed, and have a distinct cell-membrane. It would be true, as a matter of course, in the opinion of those who hold that Infusoria are composed of *sarcode*, but

[1] See Proceedings of the Boston Society of Natural History, September, 1863, p. 283; and Annals and Magazine of Natural History, December, 1864.

apparently untenable if we admit with Kölliker, which we do not, that they are unicellular, while we deny that these cilia are direct prolongations of the cells which they seem to be so closely related to, we do not assert that they are always disconnected with some form of cell in the modern acceptance of the ideal cell. We do, however, believe that they are never the filiform proliferations of a distinct cell-membrane, however much they may appear to be so, but that in such cases they arise from the cytoblastema which overlies the cells."

That vibratile cilia are "individualistic in their movements at times, just as an arm or a leg is individualized" is claimed by our author, who remarks as follows: "Cilia are commonly treated of like masses of men in an army, all moving to one determined end, as if the recorder of their movements did not think that the animal possessing them had the discriminating power of controlling the actions of any one separately. As well might one claim that the numerous legs of a centipede are not capable of individual control." The beautiful figure given indicates the individuality of the cilia, and that they are "individually controllable."

The memoir ends abruptly with an account of the lasso cells or prehensile cysts (nematocysts and colletocysts), by which, as in most other Cœlenterates, the prey is benumbed and thus rendered more easy of capture. In 1863 Clark published the opinion that the nematocysts "have an intercellular origin, and do not develop within the cells which form the layer in which they are imbedded, but commence their career, *de novo*, by free-cell formation in the cytoblastema." the latter term referring, as we understand it, to the protoplasm or parenchym of the body. Description is also given of certain "tactile bristles," which he describes as "standing sentinel at the doors of the nematocysts to give warning of the approach of any foreign body."

The *Lucernariæ* were regarded by Clark as not being truly radiate animals, but as in a degree bilateral, with a fore and hinder end. The commonly received theory that the so-called *Radiata* are founded upon the idea of radiation, was combatted by the author in 1865.[1] He gives the following reasons: "We assume that, as in all the other four grand divisions of animals, the mouth is at the cephalic or anterior extremity of the body, and that all the rest of the organism is virtually, if not really, topographically behind it, and that whatever extends from the oral end of the body *does not radiate* from that end in two, three, four or five or more directions, but trends posteriorly in so many lines parallel-wise to a longitudinal axis, and to a vertical sectant plane which divides the body into a bilateral figure. To give the idea a reality, we have but to point to the mouth of an Actinia

[1] Mind in Nature, or the Origin of Life and the Mode of Development of Animals. By H. J. Clark. D. Appleton & Co. 1865.

as the cephalic end of our bilateral figure, and looking inwardly we shall see the flat stomach forming the sectant plane, which, extended in imagination in two opposite directions, would strike the periphery of the body along two dorsal and ventral lines one hundred and eighty degrees from each other, and then, projected still further away from the mouth, would terminate finally in the posterior, adherent discoid end. Parallel-wise with this plane all of the partitions of the digestive cavity trend, like a series of superposed shelves or galleries, in direct lines from the region lying right and left of the mouth, and of the flattened parallel sides of the stomach, backward along the inner face of the cylindrical periphery, so as to subdivide the included space into as many longitudinal corridors. It is these partitions which, by their multiplied sameness, constitute, among others, the elements that embody the dorso-ventrally repetitive type; the true ideal, as we firmly believe, upon which this grand division is founded.

"We think we shall be understood now when we say that the multitudinous chymiferous canals of the disciform Æquorea and the quadruple channels of the cylindrical bell of Sarsia are two widely separated extremes of dorso-ventrally repetitive sameness; or that the numerous ambulacea of Solaster and the five of Asterias represent two extremes of dorso-ventral repetition, thrown forward, 'into rank,' to the same line with the mouth; whilst the retreating rows of Echinus, and the more differentiated ones of Spatangus and Schizaster, and the like, present the idea in a less disguised form, to be finally exemplified, in its fullest expression and clearness, in the elongated vermiform Holothuria."

The views, in these days, of the most eminent naturalists, coincides with those of Clark, that radiation is, on the whole, a superficial feature, not always constant in Cuvier's *Radiata*, though often well marked. The type has been dismembered, though the radial symmetry usually present in the members of the Cœlenterates and Echinoderms is paralleled by the articulated or segmented disposition of parts in the members of Cuvier's Articulata, and in a less apparent but true sense in the Vertebrates.

Complete and elaborate as it is so far as it extends, this beautiful memoir was evidently designed to cover at least fifteen parts, as reference is made to several chapters composing Part xv, only two parts having an actual existence. A broken shaft would represent both the author's life and this posthumous work, each symmetrical and thoroughly finished to the point where they suddenly broke off.

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The Extinct Birds of Rodrigues. By Dr. A. Günther, F.R.S., and Edward Newton, C.M.G., M.A., F.L.S. 4to, pp. 15, pls. XLI–XLIII. London, no date. From the authors.

[Zoölogy of Rodriguez.] Reptiles. By Dr. Albert Günther, F.R.S. Fishes. By the same author. 4to, pp. 3. London, no date.

The Extinct Reptiles of Rodriguez. By Dr. Albert Günther. 4to, pp. 5. London, no date.

List of the Mammals, Reptiles and Batrachians sent by Mr. Everett from the Philippine islands. By Dr. A. Günther, F.R.S. 8vo, pp. 74–79, pl. IV. (From Proc. Zoöl. Soc. of London, Jan. 14, 1879.)

On Reptiles from Midian, collected by Major Burton. By Dr. Albert Günther, F.R.S. 8vo, pp. 977, 978, pl. LXII. (From Proc. Zoöl. Soc. of London, Dec. 3, 1879.)

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Annual Report upon Explorations and Surveys in the Department of the Missouri. By E. H. Ruffner, Lieut. Eng. U.S.A. Being Appendix SS of the Annual Report of the Chief of Engineers for 1878. 8vo, pp. 1749–1867, pls. 8. Washington, 1878. From the Department of the Interior.

Proceedings of the Academy of Natural Sciences of Philadelphia. 8vo, pp. 153–184, 1879. From the society.

Ursprung und Stammverwandtschaft der Ctenophoren. [Verbal communication.] By Prof. Haeckel. 8vo, pp. 10. (Ext. from Sitzungsberichten d. Jenaischen Gesell. f. Med. und Naturwissenschaft. 16 Mai, 1879.) From the author.

Bradybates ventricosus (Tschudi) est synonyme de Pleurodeles waltlii (Mich.). Par Fernand Lataste. 8vo, pp. 8. (Ext. des Actes de la Soc. Linnéenne de Bordeaux, 2 Mai, 1879.) From the author.

Ichthyagrafiske Bidrag. VII Tillægsbemærkninger om Sugefiske og Sværdfiske. Af Dr. Chr. Lütken. (Ext. from Vidensk. Medd. fra den Naturhist. Foren. i Kjöbenhavn, 1877.) 8vo, pp. 2. From the author.

Smaa Bidrag til Selachiernes Naturhistorie. (Om vanskabte Rokkeformer; om Havkalens Forplantning, om Brugdens tidligere Forekomst ved Island og foregivne Forekomst ved Grönland; samt om den mellemamerikanske Ferskvands-Hai.) Af. Dr. Chr. Lütken. (Ext. from Vidensk. Medd. fra den Naturhist. Foren. i Kjöbenhavn, 1879–80.) 8vo, pp. 24. From the author.

Ueber einige neue und seltene Fischarten und den K. K. zoologischen Museen zu Wien, Stuttgart und Warschau. Von Dr. Franz Steindachner. (Ext. from Denkschriften d. Mathematisch Naturw. Classe d. Kaiserl. Akad. d. Wissenschaften.) 4to, pp. 52, 97 af. Wien, 1879. From the author.

Scientific Lectures. By Sir John Lubbock, Bart., M.P., etc. 8vo, cloth, pp. 187, 1 plate and 30 figures on wood. Macmillan & Co., London, 1879. From the publishers.

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The Peduncular Tracts of the Anthropoid Apes. By Edward C. Spitzka, M.D. (Ext. from the Journ. of Nervous and Mental Disease, July, 1879.) 8vo, pp. 27. New York. From the author.

The Outer ear of Blarina brevicauda. By Dr. Elliott Coues, U.S.A. (Ext. from American Journal of Otology, Vol. I, July 18, 1879.) 8vo, pp. 2. New York, Wm. Wood & Co. From the author.

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Resources and Attractions of Utah. Prepared by the Utah Board of Trade. Omaha Republican Publishing House, 1879. 8vo, pp. 74.

Writings of Samuel Hubbard Scudder. Published by the editor, George Dimmock. Cambridge, August, 1879. 8vo, pp. 28.

Note sur le Breyeria Borinensis. Par A. Proudhomme de Borre. (Extrait des Comptes-rendus de la Société Entomologique de Belgique. Séance du 7 Juin, 1879, Bruxelles.) 8vo, pp. 6.

Principal J. W. Dawson's Criticism of my Memoir on the Structure of Eozoön Canadense compared with that of Foraminifera. (From the American Journal of Science and Arts, Vol. XVIII, September, 1879.) By K. Möbius. 8vo, pp. 10.

Report of the Entomologist, Department of Agriculture, Charles V. Riley. Washington Government Printing Office, 1879. 8vo, pp. 52.

De la Meilleure Disposition a donner aux Caisses et Cartons des Collections d'Insects. Par A. Proudhomme de Borre. (Extrait des Annales de la Société Entomologique de Belgique Séance du 5 Avril, 1879, Bruxelles.) 8vo, pp.4.

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GENERAL NOTES.

BOTANY.

SIR JOHN LUBBOCK ON SEEDS.—At the last meeting of the British Association Sir John Lubbock read an interesting paper on seeds. He commenced by calling attention to the difference presented by seeds, some being large, some small. some covered with hooks, some provided with hairs, some smooth, some sticky, &c. He gave the reasons of these peculiarities, and then spoke of the modes of dispersion, by means of which seeds secured a sort of natural rotation of crops, and in other cases were enabled to rectify their frontiers. Some plants actually threw their seeds, some were transported by the wind, and many were provided with a wing which caught the wind. Dispersion was also effected by the agency of animals. This means was divided into two classes, where seeds adhered to animals by hooks, and where the same purpose was effected by sticky glands. The next point touched upon was, that seeds found themselves in spots suitable for growth. Most seeds germinated on the ground, but there were instances, as the mistletoe, where they were parasitic on trees. Such seeds were imbedded in a viscid substance, so that if dropped by a bird on a bough they adhered to it. In some cases plants

buried their own seeds, and in other instances the seeds buried themselves, the means by which these processes were effected being fully explained by Sir John, who, in conclusion, called attention to mimicking seeds, such as the Scorpiurus, the pods of which did not open, but looked so exactly like worms that birds were induced to peck at them and thus free the seeds. That this was the purpose of the resemblance he would not assert, but he threw it out as a matter for consideration.

THE FRUIT OF SHEPHERDIA CANADENSIS.—In the same locality as *Prunus pumila* (p. 649) is found *Shepherdia Canadensis* Nutt., whose fruit differs from the description commonly given. Gray's Manual states that it is "yellowish-red, insipid;" Wood's Class Book, "Berries oval, scaly, sweetish to the taste;" Nuttall, who originally described it, "Berries squamose, sweetish but scarcely edible." The berries are pleasantly acid, followed, however, by a slightly bitter taste if the skin be retained in the mouth. The color is scarlet, in this respect, as well as in the globular form and the size, closely resembling the common red currant. A dish of them would at first sight be taken for currants by almost any one. The bushes bore abundance of fruit this year, which is rather uncommon, and except in leaves, strikingly simulated well-loaded currant bushes. Bringing some home in fruit, and showing them to some children before allowing them to be tasted, they were at once said to be currants, and were eaten with a relish, showing that the children do not agree with the botanists, if these are typical berries. They are sparsely covered with scales in the form of the brown radiating hairs so abundant on the under side of the leaf, that form such pretty objects under the microscope. The description of the fruit of the buffalo berry of Upper Missouri (*S. argentea* Nutt), "edible, acid, scarlet," really answers more correctly for this. The plant does not seem to vary otherwise from the ordinary description.—*E. J. Hill.*

POTAMOGETON NIAGARENSIS TUCKERMAN.—The only locality for this plant given in Gray's Manual is "Rapids above Niagara Falls." I do not find it mentioned in other books. It occurs abundantly at South Chicago in the Calumet river, and in the pools and ditches that drain into it from Englewood eastward. It is usually in rather shallow water, often forming dense masses filling the water to the depth of several inches, and fruiting freely. In a note from Dr. Gray it is said to occur in other parts of Illinois. The plant seems a little more slender than that described in the Manual, with narrow leaves. But the "short, club-shaped, compressed peduncles," the "capitate 8–12 flowered spikes," though hardly "*few*," and the "roundish, compressed fruit, with a winged and toothed keel and angled face," and the "convolute, uncinate seed," define it clearly. It comes into fruit by the middle of June and continues throughout the summer.—*E. J. Hill.*

THE HOUSTONIA ROTUNDIFOLIA PRODUCING DOUBLE FLOWERS.—Though Chapman limits the *Houstonia rotundifolia* Michx., to "sandy soil near the coast," I found it quite common in the central or lake region of Florida. At Santa Fe lake, Fla., on January 14, 1878, I met an instance of this plant producing double flowers. Each beautiful little snow-white blossom was so crowded with petals as to form a perfect tiny rosette; the other parts varied in there being three pistils having exserted styles, while there were five included stamens. Several of the inner petals also were tipped with anthers, resembling the same feature in the water-lily. The plant grew under an old fence, the rails of which were partially decayed; but there were otherwise no artificial surroundings to which the peculiarity might be ascribed. The dimorphous character of the flowers in the genus Houstonia is worth recalling in this connection, and it is further noteworthy that the species under consideration bears apetalous fruiting flowers throughout the year.—*Henry Gillman, Detroit, Michigan.*

A SUGGESTION.—To mark the relative frequency of species in a local flora the botanists always use the terms, common, abundant, frequent, scarce, rare, very rare, etc. This is not sufficient when we intend to give a characteristic view of the vegetation of a certain district. As it is impossible to count the single individuals of each species, we should try to find out approximate proportions of the species to the whole mass of vegetation after the method which was first (in 1848) proposed by Prof. Schnitzlein in his valuable book on the vegetation of the Jura and Keuper formation. Suppose a distance of one hundred square miles divided into ten equal parts of ten square miles each. We would mark a species which occurs in each of those parts with the Roman figure x, when only in five with v, when only in one with I, etc. This would show the distribution of a plant over the whole area in question. Of course when a plant grows only in swamps, or on prairies, or in woods, these figures would indicate only the occurrence in so many parts of swamp land, prairie land, or wood land, and it would be necessary that the flora be accompanied by an accurate topographical map on which were marked the limits of wood land, swamp land, prairie land, cultivated land, etc., or else the proportion of these different soils to the whole area should be indicated. The relative number of each species in each locality could be marked by an Arabic figure from 1 to 10. So I. 1 would mean only a single specimen found on a single locality, I. 2 a few specimens, I. 3 a limited number, and so on to 10, which would mean an immense number.

A plant marked I. 1, especially when inconspicuous, would be no indication of the character of the landscape and another marked II. 2 neither, when those marked with X. 10, X. 9, IX. 10, IX. 9, etc., would be of a decided influence, giving the view a

prominent stamp. Small inconspicuous plants, for instance, *Eleocharis acicularis*, act upon the sight only in large masses (be it by millions), when a much smaller number (thousands) of woody species, for instance *Quercus alba* or *Corylus americana*, may have the same effect. Both the former and the latter we would mark by 10, as we do not count the exact number of individuals but the manner in which they strike the sight. For the intention of this method is not only to give the relative frequency of each species, but at the same time to show what part the species does play in the whole vegetation of a certain district as presenting itself to our view.

Besides these designations the geological character of a locality could be marked by the letters A, B, C, etc.

This simple method, which requires not much space in a book, would be a valuable improvement in our floral catalogues.—*Fred. Brendel.*

BOTANICAL NOTES.—There has lately been on exhibition in the window of the office of the *Providence Journal*, a magnificent fasciated specimen of the golden-banded lily of cultivation, bearing one hundred and thirty-seven blossoms. The stem is flattened in the usual way when this teratological phenomenon is seen.——The attention of botanists is called to an important contribution to American botany by Mr. Sereno Watson. It is published by the American Academy of Arts and Sciences, and is entitled a Revision of the North American Liliaceæ. It evinces the usual painstaking care and discrimination of its author, and will be welcome to the many students who have wandered through the chaos hitherto existing in this family. Many radical changes are made, but none, we believe, which will not be found for the better; certainly none for which good reasons could not be given. To instance two of these, the genus *Uvularia* retains the species *perfoliata* and *grandiflora*, while *sessilifolia* and *puberula* are brought under a genus *Oakesia*. The genus *Milla* mostly disappears in *Brodiæa*. A second portion of the same pamphlet describes a number of new species of various orders, the whole followed by a carefully prepared index.—*W. W. Bailey, Providence, R. I.*

THE SEA-WEEDS OF SALT LAKE.—The attention of the visitor to the shores of the Great Salt Lake, Utah, is sometimes attracted by the small masses of Algæ which are seen to be suspended in the brine, and to be cast ashore in little windrows on the sandy shores. Four years ago, while connected with Hayden's U. S. Geological Survey of the Territories, I made an investigation of the life of the Great Salt Lake, especially of *Artemia fertilis* and *Ephydra gracilis*, and took pains to collect in alcohol, and also dry, specimens of these Algæ, as they had been unnoticed by botanists and collectors so far as I am aware. It is probable that

these Algæ are almost the only source of food for the brine-shrimp, as they are diffused through the water in nearly equal abundance with the Crustaceans themselves, and in no case that I could see, grow attached to any objects in the lake or on the shore. The most common form is a rounded mass which lives suspended in the water.

Specimens of the Algæ collected were sent to Prof. W. G. Farlow, of Harvard University, from whom the following preliminary report has been received:

"The Algæ which you collected in Salt Lake are very interesting and, as far as I know, are the first which have ever been collected in that locality. Mr. Sereno Watson, the distinguished botanist of the King Survey, tells me that he examined a portion of Salt Lake for Algæ but without success, and thinks it probable that very few plants will be found in the lake. The specimens you sent comprise two small packages of dried material and a small bottle of alcoholic specimens. The alcoholic material is scarcely determinable, as the specific characters of Algæ, such as would be expected to occur in Salt Lake, are generally lost by immersion in alcohol. The dried material I have soaked out and examined.

"It consists largely of grains of sand and remains of small animals, mixed with which are three species of Algæ. The most abundant Alga is one which forms irregular gelatinous masses sometimes attaining a diameter of half an inch. The color, apparently much faded in drying, is brownish with a tinge of bluish-green.[1] It seems to me to be a species of *Polycystis*, and I am unable to refer it to any of the described species and have called it provisionally *Polycystis packardii*. Its distinguishing characters are the oblong shape of its cells, which are smaller than in any of the marine species of the genus which I have examined, and the firmness and lobulated form of the gelatinous substance in which they are imbedded. Besides the Polycystis is a species of Ulva, using the word in the extended sense adopted by Le Jolis, which is in fragments, so that one can form no very accurate idea of its habit. The microscopic characters, however, show that it is, with scarcely any doubt, *Ulva marginata* Ag., found on the coast of Europe. The specimens from Salt Lake agree very well with specimens from the French coast, which are considered by Le Jolis to be the species described by Agardh. The third Alga from Salt Lake is much less abundant than the others in the packages sent, and is also in poor condition for comparison with herbarium specimens. It is a species of Rhizoclonium, and it comes very near to *R. salinum* Ktz. (*R. riparium* Harv.), a common marine species of this country and also found in Europe near salt springs. The Salt Lake plant has smaller cells and

R. kochianum, a species also marine and found in

is an olive green.—A. S. P.

"You will see then that two of the three species are recognizable as marine forms, while the third, in my opinion now, is at least not to be referred to a known marine form. As a rule, the Algæ found in saline regions belong to species found in brackish waters on the coast. One might expect to find a large variety of Ulveæ and Conferveæ in Salt Lake, and it would be of interest to see how closely these inland forms approximate to the littoral forms of the eastern and western coasts."—*A. S. Packard, Jr.*

BOTANICAL NEWS.—The *Botanical Gazette* for September prints an article by Prof. J. T. Rothrock on the staining and double staining of vegetable tissue.——*Grevillea* for September contains an account, by W. L. Lindsay, of experiments on the colorific properties of lichens.——In Trimen's *Journal of Botany* for September, Mr. S. LeM. Moore discusses in an interesting way the mimicry of seeds and fruits, and the functions of seminal appendages, pointing out the resemblance of certain seeds to insects, spiders and shells. He concludes that "the insect-mimicing fruit or seed may escape from its seminivorous enemies by being passed over as an insect; moreover, insectivorous ones seizing it and finding out their mistake would be almost certain to fling it some distance away, by which means the species would stand a better chance of dispersion."

ZOÖLOGY.[1]

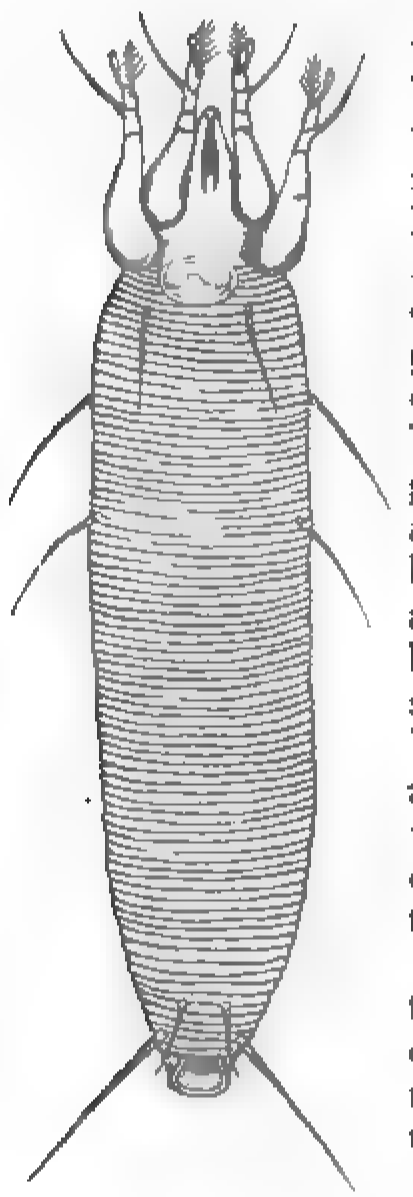
SUCCESSIVE APPEARANCE OF CHIROCEPHALUS AND STREPTOCEPHALUS IN THE SAME POND.—The pond at Woodbury, N. J., from which the types of a new species of the first-named genus were obtained, and which I called *C. holmanii*, has recently yielded specimens of a large species of Streptocephalus, which I have named *S. sealii*. Mr. W. P. Seal, who collected for me specimens of both species, tells me that Chirocephalus was very abundant, and Streptocephalus, though numerous, was not as plentiful. The consecutive appearance of these two species, the first in spring and the latter late in summer, in the same pond, seems to me worthy of record. The pond dries up during dry weather, and is not more than fifty feet in diameter. Mr. Seal, whose opinions I have learned to value very highly in reference to such matters, suggests that it is not improbable that wading and water birds carry the eggs of these branchipods and other water organisms, from place to place, in the mud or other material adhering to the feet and body.—*John A. Ryder.*

A THIRD LOCALITY FOR EURYPAUROPUS.—On the 20th of September last, I found specimens of the above-mentioned genus under sticks and leaves, in considerable abundance, at a place on the west side of the Schuylkill river, about a mile north of the

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

most northern locality first discovered. Neither larvæ nor adults differed in any way from those found earlier in the year.—*John A. Ryder.*

A Probable New Species of Phytoptus or Gall-mite.—Prof. Wm. Barbeck recently handed me a slide containing specimens of a very small mite found by him on the leaves of a maple. Upon examining the slide carefully with a power of 550 diameters, I was enabled to make a pretty fair camera sketch, which I have compared with all of the figures of the other species to which I had access, and I am led to infer therefrom that it is a new species, but shall not name it on account of the fact that those hitherto known and described, have, for the most part, been very poorly characterized. The accompanying figure of this creature will give a good idea of its appearance. It measures not quite the $\frac{1}{150}$ of an inch in length, and is almost perfectly transparent. It is found in vast numbers on the leaves of the maple, under a forest of epidermal growths, crowded together and consisting of minute disks supported on pedicels. These growths have been considered fungoid in nature under the name of "*Erineum*," but are, in reality, hypertrophied hairs, and it is now well known that they are caused by very minute four-footed mites belonging to a very singular family known since the time of Dujardin as *Phytoptidæ*. When these creatures produce galls they are always open, the opening being on the under side or edge of the leaf, and are clothed inside with hairs, amongst which the mites browse heads downward.



Whilst there can be little doubt that Phytoptus is allied, as Murray observes, to the eight-legged itch-mites, the vermiform abdomen, which is almost wholly occupied with the reproductive function, according to Landois and Briosi, one cannot help being struck by its resemblance, in this regard, to the degraded crustacean Penella, parasitic upon the marine sun and parrot fishes, and which also has an elongated vermiform, annulate abdomen also wholly given up to reproductive purposes. It appears to me not improbable that we have, in these two cases, an instance of the *homoplasy* spoken of by E. Ray Lankester. That is, that creatures widely removed from each other in the system, may become similar in structure through the prolonged influence of similar conditioning causes.

The principal characters which seem to distinguish the form here figured from others, are the robust basal joints of the legs and the long tenant hairs of what are probably the first tarsal joints; though I am not sure that these are specific characters, and it will be impossible to decide until the group has been specially studied. Meanwhile, the figure of the above-described Phytoptus, observed by me, may be of use to some specialist interested in revising the group.—*John A. Ryder.*

THE ENGLISH SPARROW (*Passer domesticus*).—Every fact touching the relations of the English sparrow to our native birds should be put upon record, to the end that a just conclusion may be reached in regard to its character. During the present month (June, 1879) Hon. Wm. H. Upson, of Akron, called my attention to the fact that a box erected for birds in his yard had, in the spring, been occupied by the sparrows; that the house-martins had taken forcible possession, driven out the sparrows and were then occupying the box, which the sparrows were constantly endeavoring to regain. Going to his grounds I found one of the martins sitting as a sentinel at the door of the box, and in a few minutes the sparrow appeared with materials for nest-building in its bill, hanging around apparently waiting for an opportunity to enter the box; it never tried to enter while the martin was sitting in sight at the door, but as soon as the passage seemed clear, made the attempt; it was every time driven away by the martin. I watched the controversy for an hour, during which many attempts were made to gain possession. The sparrow never called for re-inforcements, but twice the martin gave a sharp call which brought several others to his assistance. It was very evident that the martin was able to hold the fort.

Mr. Upson has many trees and much thick shrubbery in his yard, and although his grounds are in the city of Akron, they are filled with a large variety of our native birds, and he reports that they are all fully able to take care of themselves in the presence of the sparrow, but suggests that in large numbers the sparrows may induce a bird famine, and in that way alone tend to diminish the number of our native birds.

Prof. Elizur Wright, of Mass., was the guest of Mr. Upson at the time of my visit, and was much interested in the controversy between the sparrow and the martin. He stated that in his grounds at Medford, near Boston, the sparrows from the city attempted to take possession of boxes erected for the blue birds and the white-breasted swallow, but were driven away from the boxes and off from the grounds by these native birds. He reported the following birds as frequenting his grounds and a clump of forest adjacent to them, blue bird, white-breasted swallow, scarlet tanager, wood thrush, summer yellow bird, red start, song sparrow, chipping sparrow, grass finch, cat bird, brown thrush, gold finch, indigo finch, house and wood phœbe,

[illegible] humming-bird, Baltimore oriole, orchard oriole, white-eyed vireo, red-eyed vireo, fly catchers, king bird, cuckoo, etc. He also states that in his grounds the red squirrel is a great plunderer of the eggs of the birds.

July 8.—The sparrows in Mr. Upson's grounds have finally regained possession of their box. Mr. Upson informs me that they never made a direct attack upon the martins, but watched the box continuously for many weeks, and at every possible opportunity carried nest-building materials into it, until the patience of the martins was exhausted, their associates were called together in consultation, and the box abandoned.—*M. C. Read, Hudson, O.*

Destructiveness of English Sparrows.—I am informed by Mr. John M. Shorten, of Cincinnati, Ohio, of a humming-bird brought to him to be mounted, which had been killed by English sparrows. A friend of Mr. Shorten witnessed the attempts of the pests to destroy the little hummer, but unfortunately did not succeed in rescuing it until life was nearly extinct.—*Elliott Coues, Washington.*

Curious Habit of the English Sparrow.—I have recently noticed what seemed to me a curious habit of our English sparrow. On several occasions whilst walking through the city, I have seen them take potato bugs and other insects when on the wing, after the fashion of swallows.

I have also repeatedly noticed these sparrows climbing tree trunks in spirals exactly like a creeper, stopping at intervals to pick up insects and the nests of our common yellow caterpillar from the interstices of the bark. Sometimes the bird would flutter to the ground and reascend, sometimes go from the ground to the lower branches and then try another tree.—*J. R. Taylor, M.D.*

Swallows Feeding on Bayberries.—During a visit at Beach Haven, N. J., I noticed, September 10, 1878, great flocks of swallows, which I took to be *Cotyle riparia*.

I saw them alighting by millions on the bare sand flats, whole acres being covered at once; some coming, others going, and all as they sat, facing the wind.

The ground from which they had just flown was, of course, dotted with their freshly dropped excrement, and I was astonished to find therein the hard seeds of the bayberry (*Myrica cerifera*). I at first refused to believe the obvious inference, supposing it to be a settled fact in natural history that swallows were wholly insectivorous. But from further observation the conclusion seemed inevitable that they had fed upon the bayberries. I learned, moreover, that they had been seen to alight upon the bushes, which were afterwards found to be stripped; and the opinion was expressed by old residents of the place, that the [illegible] were attracted there by the berries. I was anxious to

pursue the subject further but was obliged to leave next morning. Some of my friends, however, endeavored to procure me specimens for identification, but failed to find them. The birds were probably on the eve of migration, and arranging therefor. Perhaps their ordinary pabulum is too quickly digested to support them on their flight, and they therefore instinctively lay up a store of more durable food.—*James Altinson.*

NOTES ON THE SLAVE-MAKING ANT.—For the past three years I have been observing a large colony of slave-making ants (*Formica sanguinea*). The formicary is in the grove which surrounds the house, thus affording me an excellent opportunity to see the battles and raids upon other species, and to note their curious proceedings in many other respects.

On August 1st and 2d I witnessed the greatest battle I ever saw between the slave-makers (*F. sanguinea*) and the black ants (*F. fusca*). The distance between the two colonies was one hundred and twenty feet. The immense number of individuals composing the colony of slave-makers may be partly estimated by seeing them on the war path, which was about one foot in width and one hundred and twenty feet in length—not thinly scattered but a vast moving phalanx.

The battle-field was about twenty-five or thirty feet in circumference. The blacks were a grand army that would not flee, and the ground was soon literally covered with the combatants.

It is stated in the August number of the AMERICAN NATURALIST, page 526, that by means of the microphone Mr. T. S. Tait has been able to hear the roar of a black ant when attacked by its companion. When the ants were first attacked in this great battle, I certainly heard a roar without the aid of a microphone! Was it the busy tramping feet that I heard? The roar—I do not know what else to call it—lasted only a few moments, whereas the battle lasted four or five hours before the reds gained possession of the vast nurseries of the blacks. It took them nearly two days (they cease work at night) to transport the pupæ and the mature prisoners to their own dominions.

It is a singular fact, that in all the battles which I have witnessed during the past three years the reds have never been repulsed by the blacks, but have always come off victorious. I think the main reason why the blacks are so easily slaughtered is the fact that they never let go their hold on their adversary. A black ant will fasten its mandibles upon a leg of the red warrior, another red cuts the head off, and it is not uncommon to see as many as three black heads hanging to the legs of one of the reds, while the headless trunks of the blacks are strewn thickly over the ground. Very few reds are killed compared with the blacks.

The blacks are not the only species which the slave-makers attack. The brown ant (*F. schaufussii*), and the yellow variety

(*P. schaufussii var. americana*), both fall victims to their insatiate rapacity. Large numbers of these brown and yellow ants are reared in the slave-making colony, and they make excellent nurses for their masters. They also make raids upon two species of *Aphænogaster*, but these do not remain long with their captors. But I am happy to state that there are two species of ants in the grove which the red marauders dare not attack—*Camponotus meleus* and *Polyergus lucidus* they never attack, however small or weak the colony.—*Mary Treat.*

Notes on Pacific Coast Mammals.—The curious case of a breed of one-toed hogs, mentioned by Dr. Coues, is paralleled, at least in an individual instance, by that of a one-toed deer, the four feet of which were presented recently to the California Academy of Science. Unfortunately the only parts sent were the metatarsals and toes, so that it would be difficult to be certain of the species further than that it was a Cariacus. The deer was killed in Mendocino county, Cal., but no information as to the existence or non-existence of others resembling it has yet been obtained. In all cases the third toe was the only one utilized for progression, but the extent of the development of the fourth toe differed in the respective feet.

Mr. Chapman, a taxidermist of San Francisco, has a deer horn which is eighteen inches long, has an external basal prong five and a-half inches long and an internal posterior prong four and a-half inches long, branching off six and a-quarter inches from the slightly re-curved tip of the main antler.

In the collection of Mr. Lorquin, another taxidermist of San Francisco, there was, not long since, a very large pair of horns of *Cervus canadensis*, full grown yet with the velvet still perfect. The left horn measured four feet eleven inches along the curve, the right, about an inch less. The right had four branches near the base, and divided into four prongs at the crown; while the left had but three basal prongs and three coronal branches. The distance between the horns at their greatest outward curvature was three feet eight inches, and the tips were two feet six inches apart. Will some reader of the Naturalist kindly inform me whether similar differences between the two horns of this species are the rule or the exception; and also whether the large palmated anterior basal prong of the male reindeer's horn usually occurs on one horn only or on both?

The lynx of Alaska, which I suppose is *Lynx canadensis*, appears to attain very large dimensions, since the largest among several large ones in the possession of Mr. Blunt measured four feet one inch from the tip of the nose to that of the tail. This gentleman had also an albino gopher of a dirty white tint. By the term "gopher" I do not mean the Spermophilus, which is often miscalled by that name, but the true gopher (*Thomomys bulbi*[illegible]).—*W. N. Lockington.*

HABITS OF SPERMOPHILUS RICHARDSONI.—I have received the following interesting communication, which gives some new light upon the hibernation of this species.—*Elliot Coues, Washington, D. C.*

FORT ELLIS, MONTANA, Sept 8th, 1879.

Dr. Elliott Coues, U. S. Army, Washington, D. C.

SIR:—So little has been written in regard to the so-called "gopher" (*Spermophilus richardsoni*), at least that I have seen, that a few facts which have come under my own observation may be welcome to you.

I have always supposed that the gopher hibernated, but during the winter of 1878–79, while stationed at Fort Custer, Montana, I often saw them in December, January and February, playing about on the snow, which had been trodden down for a few feet around the entrance of the burrows. Small zig-zag paths led from hole to hole, showing that their sociability was continued during the winter. Some of the holes noticed had no foot-marks around them, being clean, circular openings in the snow, as if the gophers had burrowed up to the surface from below, and then found it too cold to come out. Those observed were seen when the day was bright and warm, usually about noon. When a new snow fell and covered the holes, the gophers remained inactive for some days, at least until the storm was over, and then came out to sun themselves. From some of the holes no gophers were seen during the winter, while from others they were noticed almost every pleasant day during that season. I have seen no young ones except in June and early in July; the smallest ever seen were noticed about the middle of last June, while I was walking a short distance from this post. I then saw them only a few yards off, a female with three young, gamboling in the sun, very much like young kittens. One was noticed running around after its own tail, as I have seen kittens doing. At my approach the old one disappeared in the burrow with the usual squeak and suggestive flirt of the tail; the young ones stopped their play and regarded me with much interest, yet manifested no disposition to escape. My setter dog, which had followed me, went up to them and took one in her mouth and brought it to me alive. I then, without any difficulty, picked up the others and held them in my hands for some little time. They manifested no fear at all, and seemed perfectly contented, even showing no desire to escape when placed on the ground again. I had to put them in the burrow before they would disappear. These were the first I had ever seen which showed no fear of man or dog. From their size, not longer than four or five inches, I judged them to be about a month old.

Regarding the distribution of the gopher, I may add that I have seen the animal in Wyoming, Utah, Colorado and Montana, from the Platte to the Marias river. Very Respectfully,

S. M. SWIGERT, *1st Lieut. 2d Cavalry.*

Oviparous Snakes.—In his article "On the question 'Do snakes swallow their young?'" (Proc. Am. Assoc. Adv. Sci. for 1873) Mr. Goode states that certain species of snakes, with which he includes *Heterodon platyrhinos* and *Tropidonotus sipedon*, are ovo-viviparous.

I have in my possession two eggs of *H. platyrhinos* from a set of twenty-two ploughed out of the sand at East Hampton, L. I., on the 10th of September, 1877.

The fact that these eggs had been buried and left in the sand, and that of the two in my possession one did not hatch till the fourth day after its discovery (the other being then put in alcohol to prevent its hatching) shows conclusively that this species is sometimes, at least, oviparous.

Can it be true of this species and of *T. sipedon*, which a communication from Prof. Cope states to be oviparous, that they are oviparous in some cases and ovo-viviparous in others, as is supposed are some of the Eutænias?—*F. W. Cragin.*

Stratagem of a Wasp.—One day when in Southern New Jersey, wearied with the heat, I was resting under a large oak, when my attention was drawn to what at first seemed a strangely variegated insect on the trunk of the tree; closer examination showed the apparently single insect to be really two insects, one a wasp the other a roach. My approach frightened the wasp off, but the roach did not move, at least very far. Wishing to understand why the wasp had been so near the roach, I quietly watched till the wasp returned. It had no sooner alighted, than going to the roach it seized it by the base of one of its antennæ and proceeded to back up the tree, dragging the roach after it. I soon perceived that the probable reason the roach did not escape when the wasp had been frightened off was, that it had been stung. It is well known that wasps frequently sting spiders and larvæ just sufficiently to paralyze them, so that they may not decay before the young, for whom they are destined, are in condition to feed upon them. But it seems in the instance above cited, as if the wasp had only so far injured the roach as to render it incapable of escape, but not incapable of walking. By which stratagem it was thus saved the labor of bodily carrying its victim to its nest. Where its nest was, and whether the roach was destined to be food for the young to be, I could not ascertain, for unwittingly I frightened the wasp off again, and it did not return while I remained by the spot.—*Henry Turner.*

Beleostoma piscivorous.—In the spring of 1878, at Ithaca, N. Y., I had confined, in a jar of water with stickle-backs (Gasterosteus) and other fishes, a large specimen of a water-bug (Beleostoma). At different times I found dead fishes in the jar, and surmised, from the appearance of a wound on each of them, that the water-bug had been the cause of their death. This sup-

position was afterwards corroborated by seeing a fish vainly struggling to free itself from the Belostoma that had pierced it with its beak and was, to all appearance, pumping out its blood. This particular specimen of Belostoma was in great need of nourishment, for it provided for over a hundred plump little red mites that were attached to different portions of its body.—*Henry Turner.*

NORTHERN RANGE OF CERMATIA FORCEPS.—Mr. Samuel Henshaw writes us that of this Myriopod the museum of the Boston Society of Natural History contains six specimens taken in Massachusetts, and that he knows of three others found in the same State. Mr. F. G. Sanborn tells him that it has been taken in Milford, N. H. Mr. J. H. Emerton states that it has also occurred in Essex County, Mass.

THE BRAIN OF INSECTS.—An interesting paper, by E. T. Newton, on this subject appears in the *Quarterly Journal of Microscopical Science* for July. The author refers to the complicated internal structure of the brain of insects as first pointed out by Dujardin. Faive has shown that the power of coördinating the movements of the body is lodged in the infra-œsophageal ganglia ; this being the case, Newton thinks that both the upper and lower pairs of ganglia ought to be regarded as forming parts of the insect's brain. Brandt, in a paper read September 1st before the French Academy, states, *inter alia*, that it is untrue that all insects have a subœsophageal ganglion separate from the others (*Rhizotrogus*, *Stylops* and *Hydrometra* have not). The circumvolutions of the brain are found in *all* insects, in various developments, and the development differs in individuals of the same species. In general, the development of the hemispheres, but not of the whole brain, is related to instincts and habits. In some insects having two thoracic ganglia, the first is simple, the second compound, in others both are compound. The transformation of the nervous system takes place in some insects by reduction of the number of ganglia, in others by an opposite process.

AGENCY OF INFUSORIA IN FERTILIZING SEA-WEEDS.—It appears from the studies of Prof. Dodel-Port, the eminent Zurich botanist, says *Nature*, that certain infusoria harbored by the red sea-weeds, return the favor by fertilizing the sea-weeds on which they live. Thus the currents formed in the water by the bell-shaped animalcules (Vorticella) situated on the shrub-like branches of a Polysiphonia, bear the otherwise immovable spores (antherozoids) of this Alga to the female plants, which are thus fertilized, just as pollen-collecting insects fertilize willow blossoms or other flowers ; and as many insects feed on pollen, so the animalcules or infusorians feed on the spores of the sea-weeds.

MIMICRY IN A SNAKE.—In 1879, while out with the Hayden Survey, I was detained about a week, by high water, on the south

bank of the San Juan river, near the line between New Mexico and Colorado. While out one day with my guide, we came across a very large bull-snake (*Pityophis* sp.?). The reptile was suspended on some small dead oak trees about two feet from the ground. These little trees were about as thick through as the snake, and the bark was ringed and spotted much as he appeared. We went close to the snake, but he did not stir, remaining apparently stiff and rigid like the sticks upon which he lay. We viewed him for some moments, commenting upon his singular position and appearance, when "Frank" finally shot his head off. As this snake closely resembled, in size and color, the little slender oaks which abound in that region, and which are often found bent to the ground, dead, it occured to me that he was practicing deception, either to enable him to capture a bird or other prey, or to conceal himself from his enemies.—*Chas. Aldrich, Webster city, Iowa.*

VIBRATIONS OF THE TAIL IN SNAKES.—I had occasionally seen this manifestation in some of our common, harmless snakes, in years past, but my attention was specially directed to it last year, while making collections for the National Museum and the Zoölogical Garden, Philadelphia. Among my captures were some large specimens of a species of wolf-snake (*Coluber obsoletus confinis*). Whenever these reptiles were disturbed or annoyed, they would vibrate their tails precisely like our rattlesnakes, and with a very similar sound, snapping at any movable object within reach. They had a general resemblance in color to our rattlesnakes, and if met unawares in the dry grass, one might well believe on the instant that he had encountered a genuine massasauga!—*Chas. Aldrich, Webster city, Iowa.*

THE HABITS OF THE ORANG.—In an interesting paper on the orang, read by Mr. W. F. Hornaday at the Saratoga meeting of the American Association for the Advancement of Science, he records the following facts and impressions from personal observations in Borneo:

"Each individual of the Bornean orangs differs from his fellows, and has as many facial peculiarities belonging to himself alone as can be found in the individuals of any unmixed race of human beings. According to my experience," Mr. Hornaday said, "orangs differ from each other fully as much as either Chinese or Japanese, if not more. The faces of the more intelligent orangs are capable of a great variety of expression, and in some the exhibition of the various passions which are popularly supposed to belong to human beings alone, is truly remarkable. I had in my possession, in Borneo, four young living orangs. Three were dull and intractable, but the fourth was a perpetual wonder both to Europeans and the natives themselves. For weeks it lived in the same room with me so that I watched it

almost constantly. The expression of its face was highly intelligent, while the intellectual development of its forehead and entire cranium would have been quite alarming to any enemy of the theory of evolution. This specimen was a fine healthy male infant about seven or eight months old, twenty-two and a-quarter inches in height, thirty-seven inches in extent of arms and fifteen and a-half pounds in weight. He exhibited fully as much intelligence as any child under two years of age, with all the emotions of affection, dislike, anger, fear, cunning, playfulness and even ennui. When teased beyond endurance he would first whine fitfully, but if the teasing were continued, he would throw himself upon the floor, kicking and screaming and catching his breath as loudly and naturally as a big spoiled child. He was afraid of strangers as a rule, but decidedly attached to my Chinese servant and myself. When alarmed by a large dog or other animal, he would shuffle up to me and climb with all haste into my arms. When a cat came near him he would grab it by the tail with the very same action and bright, mischievous expression of face that we have all seen in human children.

"Last year while on a collecting expedition for Prof. H. A. Ward, I had ample opportunities to study the habits of the orang outang in its native forests. I visited Borneo in August, 1878, for the sole purpose of obtaining specimens of the Bornean Simia and to study the different species. I visited the territory of Sarawak and for two and a-half months devoted my entire time to hunting the orang along the River Sadong and its tributary, the Simujan. This whole region is one vast swamp, covered everywhere with a dense growth of lofty virgin forest. During the fruit season, from the middle of January to May 1, the food of the orang is the durlon, mangosteen and rambuton. During the hot months of May, June and July they retire far into the depths of the forest, and are exceedingly difficult to find. But during the season of the heaviest rains, from August to November, when the forests are flooded, the orangs are found in the vicinity of the rivers. I soon found that the only way to reach them would be to paddle up and down the rivers and watch for them in the tree tops. Near the source of the Simujan river, and far beyond the last Dyak village, we found great numbers of old orang nests and some which were quite new. The nest consists of a quantity of leafy branches broken off and piled loosely into the fork of a tree. The orang usually selects a sapling and builds his nest in its top, even though his weight causes it to sway alarmingly. He often builds his nest within twenty-five feet of the ground and seldom higher than forty feet. Sometimes it is fully three feet in diameter, but usually not more than two, and quite flat on the top. There is no weaving together of branches. In short the orang builds a nest precisely as a man would build one for himself were he obliged to pass a night in a tree top and

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exists to-day), who is prejudiced against Darwinian views, go to the forests of Borneo. Let him there watch from day to day this strangely human form in all its various phases of existence. Let him see it climb, walk, build its nest, eat and drink, and fight like human 'roughs.' Let him see the female suckle her young and carry it astride her hip precisely as do the Coolie women of Hindoostan. Let him witness their human-like emotions of affection, satisfaction, pain and childish rage—let him see all this and then he may feel how much more patent has been this lesson than all he has read in pages of abstract ratiocination."

ZOÖLOGICAL NEWS.—In his presidential address before the British Association, Prof. Allman takes the ground that the deep-sea *Bathybius* may be an organism, as he thinks it not easy to believe that the very elaborate investigations of Huxley and Haeckel can be easily set aside. Huxley, at the close of the address, stated that his mind, at present, was in a state of suspense about it, though within a short time he had disowned it. Haeckel, himself, has, in recent papers, urged its recognition as an organism, while we may add that Dr. Bessels, in a letter to us, thinks that under the circumstances it is best to wait for more light as to the organic nature of the Protobathybius which he examined in the high Arctic regions.——The pamphlet of Prof. Moebius has made a strong impression on some minds previously in doubt, that Eozoön is of mineral rather than organic origin.——In the Proceedings of the Natural Science Association of Christiania, Norway, Prof. G. O. Sars gives excellent drawings of three whales, *Balænoptera rostrata*, *B. musculus* and *B. sibbaldii.* One can form some idea how these whales look from such admirable and evidently life-like sketches.——The Zoölogy of the Fiords near Bergen, Norway, by the Rev. A. M. Norman. (*Journal of Conchology*, II, 1879. Extracted, pp. 77.) This paper contains a list of 261 species of Mollusca collected at Bergen, Norway, by the author, and a supplemental list of ninety-two more which have been quoted from that region. No new species are described, but the notes on the synonymy of the species and their geographical distribution make the article both valuable and interesting.

ANTHROPOLOGY.[1]

PREHISTORIC IMPLEMENTS OF THE RIVERS COYOTE AND GUADALOUPE, SANTA CLARA COUNTY, CAL.—Some three years ago my interest was awakened concerning prehistoric implements by finding what were, without doubt, stone and flint celts, though of rude workmanship.

Before this time there had been found in various places throughout the valley, while plowing fields and digging away river banks in bridge building, mortars in different stages of preservation.

[1] Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.

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Uxmal. A long sojourn in the interior of the peninsula enabled him to study the inland dialects. The words taken from these form an important part of the dictionary, and are quite new. The coast dialects, mostly of the northern part of Yucatan, form the groundwork of the compilation, and additions were made to it from several ancient manuscript lexicons. The illustrious author had just terminated the letter U when, in 1859, death put an end to his labors. Subsequently, in 1870, Don Carlos Peon prevailed upon Dr. C. H. Berendt to digest from the materials on hand the remaining four letters of the alphabet. The work is a good-sized quarto of 437 pages, with two prefaces, and bears the title, "Diccionario de la lengua Maya, por D. Juan Pio Perez" (Merida de Yucatan, 1866–1877). Its publication was superintended by Eligio Ancona, a friend of the deceased author, and Dr. Fabian Carillo Suaste has added a biographical notice of Perez in twenty pages. The number of vocables explained amounts to 22,000; their meanings are given in concise items, worded with great precision. Syntactic examples are not often added as illustrations of words, though terms of archæological import are provided with longer explanations. Maya possesses considerable facilities for word composition, and we often find words counting from five to seven syllables; this is partly due to the circumstance that this idiom is simultaneously a prefix and a suffix language, partly also to the frequent use of syllabic reduplication.

The International Anthropological Exhibition at Moscow, which opened there on the 15th of April last, is reported in the papers to have been a great success. It took place in an immense building which is used in winter for drilling troops. The exposition was divided into several sections, among which those of archæology, craniology and ethnography played the chief part. There was also a department in which was shown, partly by pictures and partly by objects, the different methods of rearing children, swaddling, cradling, etc. The section of craniology embraced from 1200 to 1500 crania from various provinces, among which the Russian skulls are naturally in the majority. The archæological was also especially interesting. The exposition was completed by a congress, held from the 16th to the 25th of April, in the Polytechnic Museum, the meeting place of the Society of the Friends of the Natural Sciences. A second session took place from the 8th to the 17th of August, at which delegates from the various European states were present.

The third number of the *Revue d'Anthropologie* for the current year opens with a paper of seventy pages, by Dr. Paul Broca, entitled, "Cerebral localization; Researches upon the olfactory centres." The sections of this exhaustive treatise are as follows: 1. The role of comparative anatomy in the study of cerebral localization. 2. The olfactory apparatus of the mammals. 3. The olfactory centres among anosmatics. 4. Remarks upon the

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It is impossible to give any conception of the vast amount of research in this valuable essay in a short review, and, therefore, our readers are referred to the paper itself.

In the same number of the *Revue* will be found a report upon the Ethnographic chart of France, by Dr. Gustav Lagneau, and a criticism of several works upon circumcision as practiced in various parts of the world, by M. Zaborowski.

GEOLOGY AND PALÆONTOLOGY.

Geological Notes.—At the Saratoga meeting of the American Association for the Advancement of Science Prof. J. P. Lesley, State Geologist of Pennsylvania, read a very long paper on the progress of the Second Geological Survey of Pennsylvania. The very valuable results accomplished by this survey, both for scientific and economic purposes, were fully set forth, and the importance of completing it was dwelt upon.

Prof. R. P. Whitfield gave notice of the occurrence of rocks in Central Ohio, representing the Marcellus shales of New York. A brief dissertation on the geology of Port Henry, New York, was presented by Prof. T. Sterry Hunt, of Montreal.

Prof. John W. Chickering, Jr., gave a description of the newly discovered cave at Luray, Page county, Va., which he said surpassed the Mammoth cave in beauty and in the size of some of its chambers, and was inferior only in total extent.

Miss Emily A. Smith, of Peoria, Ill., read a paper on the great Oberstein industry, showing the methods of cutting, coloring and polishing agates and secondary gems. She illustrated her remarks by a very fine collection of specimens, which were greatly admired. In the little German village of Oberstein and its vicinity are the 189 mills which cut and polish the countless agates before they are scattered to the four corners of the earth. She visited the locality last season. Through this region is a ledge of trap rock or metaphyx, which was formerly quarried for agates. These quarries are now deserted, and all the agates worked are imported yearly, principally from Brazil, and sold at public auction, the owners of the wheels buying each the amount he can work up during the year. Many of these mills date back to the middle ages. After the secret of coloring was discovered from the Romans, it was found that the Brazilian agates were much more porous, and consequently more readily received the coloring matter. The coloring is principally done at the houses of the workmen.

Prof. F. W. Clarke displayed a specimen of graphite from the Ducktown copper mine, and read a brief paper on it. J. W. Osborn, of Washington, read notes on a peculiar case of corrosion of tin; and Prof. C. H. Hitchcock gave an account of the Blue Hill, Maine, copper veins.——Bernhard Cotta, the geological writer, whose death was announced in September, was born

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D'Abaddie, speaking of the determination of altitudes by the species of plants growing at various heights, alluded to by M. Woëikoff, said that during his travels in Abyssinia, after having made known to several botanists the fact that vegetation was distributed with great regularity on the mountains, he was invited by some botanists to verify the height of a mountain that he had indicated from native information as lower than a neighboring peak. The trees which had been indicated as growing on the summits of the two mountains showed that the lower one ought to have been the higher. The two mountains were surveyed hypsometrically, and the results showed that the botanists were right and the natives wrong.

In the annual address on the progress of geography at the anniversary meeting of the Royal Geographical Society, Mr. C. R. Markham stated that "an important advance towards the solution of one of the chief Asiatic geographical problems has been made this year, namely, the discovery of another section of the unexplored course of the Brahmapootra. One of Col. Walker's indefatigable native explorer's has traced and surveyed the Sanpu, the great river of Thibet, for two hundred miles beyond Chetang, the most eastern point to which it had hitherto been followed. Here the river turned southwards into the hills and between this point and that reached by Capt. Wilcox on the Dihong, in his journey from the Assam plain, in 1825, there is a comparatively short gap. But in that interval there is a fall of 8000 feet and upwards, so that the complete discovery of the still unknown portion will probably disclose a scene of wonderful sublimity—one of the last and perhaps the grandest of nature's secrets.

Lieut. Wheeler's Survey Work in Oregon, 1878.—Mr. J. W. Goad, one of the survey party, sends the following account of Lieut. Wheeler's operations in Oregon during the past year, to the Royal Geographical Society:

"On the road northwards from Reno, in Nevada, along the Californian eastern boundary, Pyramid lake, which receives the Truckee river and has no visible outlet, was explored; it is forty miles long, of immense depth, and conspicuous for its white columnar rocks, and is probably the least known of the North American lakes. It appears an open question whether there is a subterranean drainage in this part of North-west Nevada, or whether the dry climate evaporates the surplus water in the valleys. Crossing the volcanic Warner range, the oasis of Surprise valley, a fertile space of fifty miles in the midst of an arid sage-bush country, was visited and its thermal springs examined. Oregon was entered near Mount Bidwell, a bluff terminating the Warner range to the north, and here the party was organized, one of its objects (approved by Gen. Humphreys) being to make a complete reconnaissance of the Cascade mountains and a sur-

vey of the area between them and the 119th meridian. After crossing the arid and volcanic Oregon desert to the alkaline lake Albert (where the party narrowly escaped Indian attack) a peculiar difference was observed between the valleys of the Chewan-can and Summer lakes, the latter though only 300 feet lower, and but a few miles distant, having a considerably higher temperature. Its waters were strongly impregnated with borax, etc. The Klamath lakes were also visited and found to present the same typical features as Pyramid lake, undoubtedly belonging to the Great Basin plateau. At Klamath Lieut. Wheeler divided the party, himself exploring the Cascade range parallel to the Pacific coast, and Lieut. Symons, Mr. Goad and others carrying the triangulation to the north. Mount Pitt, 4000 feet above the country level and 10,000 feet above the sea, was scaled with great difficulty on account of lava, fallen timber and rock-slides; the latter are accumulations of débris held in position by some slight and unseen projection, and only requiring the weight of a man or removal of a stone to set them in motion.

"From another peak, Crater lake came in sight—a vast body of water confined in vertical cliffs 2000 feet in height; its area is about fifty miles and the geological evidence indicated comparatively recent volcanic action. Proceeding northwards many huge piles of rock, deep snow banks and innumerable small lakes were found, the party, on one occasion, passing through a frozen snow tunnel seventy to eighty feet thick. This work on the mountain crest was at last stopped by the dense forests and tangled undergrowth, thousands of acres of which are often set on fire by the Indians when driving the game, the entire consumption of oxygen in the woods causing the flame to rise and form a sheet miles in length and from one hundred to five hundred feet high.

"Leaving the mountains for the Deschutes valley, it was found that the turbulent river of that name, after apparently emptying itself into a lake with no outlet, percolated through piled up masses of lava on its shores, and reappeared ten miles further north. It can never be navigable on account of its numerous cascades and rapids. Mount Jefferson was visited but found impracticable from the lateness of the season. On the road from its base to Dalles, on the Columbia river, the warm springs, much visited by Indians, were examined—their waters collect in basins which are impregnated with a green mineral substance. Interesting data concerning Mount Hood (12,000 feet) were obtained from Mr. Walker, of the Warm Spring agency, who had ascended it. Far above the snow line, hot steam issues from craters on its side; five hundred feet from the top is a large basin with the main crater giving out sulphurous steam. Other craters and huge glaciers exist also on its south-east side. The White river, which rises in Mount Hood, owes its name to a sediment of pulverized pumice which is washed far down the

Columbia river in quantities sufficient to form white dunes on its shores by the action of the winds. Its falls were some 180 feet high.

"At Dalles a base line was measured and a series of triangles carried into Washington Territory. In summing up the capabilities of Oregon, which, west of the Cascades, are well known to be very great, it is observed that although to the east of that range the rain-fall is not great, the land is very fertile in the Deschutes basin, and the supply of water for irrigation abundant."

ARCTIC EXPLORATION.—In 1880 Lieut. Weyprecht of the last Austro-Hungarian Polar Expedition, intends starting for Novaya Zemlya, to remain at least one year, to take meteorological, hydrographical and other observations. The expenses are to be defrayed by Count Wilczek, who may himself accompany the lieutenant.

On June 3, 1879, the Dutch North Polar Expedition again sailed from Amsterdam on board the schooner *Willem Barentz*. They will first visit Barentz's Ice-haven and erect a suitable monument to his memory. A voyage into the Kara sea will be attempted. Meteorological, zoölogical and other observations and deep-sea soundings will be made as on her previous voyage last season.

Capt. A. H. Markham left England early in May last for Tromsö, whence he sailed in the little yacht *Isbjörn* to undertake an examination of the ice between Spitzbergen and Novaya Zemlya, and ascertain the practicability of reaching the west side of Franz Josef Land and advancing further north along its coast.

The steamer *Jeannette* sailed from San Francisco on July 8th for Behring strait. This vessel was formerly H. M. S. *Pandora*, and under Capt. Allen Young made two voyages to the Arctic regions. She is 420 tons burden, and has been most liberally equipped and supplied for her present voyage by her owner, Mr. James Gordon Bennett, at an expense of $300,000. By an act of Congress she has been enrolled as a vessel of the U. S. Navy, and the officers and crew are subject, therefore, to naval discipline. They are thirty-two in number. Lieut. George W. De Long is in command; he was, in 1873, the navigator of the *Juniata* that, with the *Tigress*, went in search of the *Polaris*. Among the officers are a meteorologist and a naturalist. The crew are picked men, and several of them have had experience in Arctic navigation. The *Jeannette* arrived at Ounalashka in the Aleutian islands on August 2d. After coaling there, she would proceed to St. Michael's, Alaska, where dogs and sledges were to be shipped.

The Franklin Search party landed from the ship *Eothen* on the north shore of Hudsons bay, near Depot island, on August 9, 1878. During the following months careful surveys were made of the adjacent coast from Cape Fullerton to Marble island, and journeys taken into the interior. On April 1, 1879, the party

with four additional Esquimaux and their families, making in all sixteen souls with four sledges and about sixty dogs, started for King William Land.

GEOGRAPHICAL NEWS.—The long sojourn of the Russian troops in Bulgaria and Roumelia has been fruitful of results to geographical knowledge. A series of astronomical and geodetic observations have fairly completed a network of triangulation and maps, based on the data thus obtained, which will soon appear.——The council of the Royal Geographical Society have determined to provide instruction in surveying and mapping, including the fixing of positions by astronomical observations, for those of their countrymen about to visit the less known portions of the globe. ——Commander V. L. Cameron, the well known African explorer, the *Academy* states, has made an interesting journey through Syria and along the Tigris to Bagdad, in order to ascertain the practicability of a railroad from the Mediterranean to the Persian gulf. He found that there were no physical difficulties in the way, and that the local traffic alone would prove remunerative. ——The committee of the Palestine Exploration Fund (English) will issue a subscriptional large paper edition of their survey of Western Palestine. The number of copies will be limited to 250. The work will comprise six or more quarto volumes and the great map in twenty-six sheets. The price will be twelve guineas. No cheaper edition is to be published. The American Survey map of Eastern Palestine is to appear in the same form a little later.——H. M. S. *Alert*, Sir George Nares commander, on her voyage to Magellan straits, in the autumn of 1878, took soundings over the Hotspur and Victoria banks. These singular isolated shoal banks, lying between the parallels of 18° and 21° S., and distant fifty to sixty leagues from the South American continent, average in their depths from twenty-five to thirty and thirty-five fathoms, and so far as explored are composed of dead coral worn down to a level surface and smoothed with a very thin incrustation of fine *Polyzoa*. The observations of Sir George Nares lead him to infer that these banks were once reefs of living coral with shallow water over them which have subsided to their present depth, but that the subsidence was too rapid for the reef-building coral animals to keep pace therewith, and the banks are now at too great a depth for the coral to exist.

MICROSCOPY.[1]

THE POSTAL MICROSCOPICAL CLUB.—This club, whose work was suspended last winter on account of postal difficulties, has resumed its operations again. It was presumed by many that the effect of the new postal law which went into effect last spring would be to permit the mailing of slides as heretofore. It was found, however, that the single wooden boxes which had always been

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

used were not at present satisfactory to the Post-office Department. For the purpose of absolute safety a double security was required, and the wooden box must be itself enclosed in a metal case. A feasible method of accomplishing this has now been introduced by the club by wrapping around the box a sheet of thin brass, left open at the ends and held in place by the twine with which the box is tied up. This method is approved by the department, and is only a trifling addition to the weight or expensiveness of the box; and the brass cover can be used without renewal for an indefinite length of time. The following officers have been elected: President, Rev. Samuel Lockwood, of Freehold, N. J.; secretary, Rev. A. B. Hervey, of Taunton, Mass.; assistant secretary and treasurer, Joseph McKay, 24 Liberty street, Troy, N. Y.; managers, R. H. Ward, M.D., Troy, N. Y., and C. M. Vorce, Cleveland, O.

A New Local Club.—Early in August the "Griffith Club of Microscopy" was organized at Detroit, Prof. Samuel A. Jones being chairman of the meeting. The new club was well represented at the Buffalo meeting of the American Society of Microscopists. It is proposed to hold weekly meetings for study and work, beginning October 1st, at a private office.

West Chester Philosophical Society.—This society is taking a place among the most active and successful microscopical societies. At the September meeting an excellent note on the fertilization of plants, with special relation to the question of insect fertilization, was read by Dr. J. R. McClurg, chairman of the Microscopical Section. In opposition to the theory of Darwin, Lubbock and others, that the sweets (and colors?) of flowers exist expressly for insects, in order to attract their visits and thus secure cross-fertilization, he states with much prominence, if not formal approval, the theory of Rev. Geo. Henslow, that the sweets existed before insects used them, though they have been subsequently increased by such use; that self-fertilization and not cross-fertilization is natural to the plants, and that self-sterility has resulted from habitual insect fertilization, and is therefore a dire necessity and not an original and beneficial trait. Mr. Wm. T. Haines also delivered an able address on cryptogamic botany, in which the beauties of the Pezizas and the ethics of scientific intercourse were dwelt upon with equal vigor and effect.

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SCIENTIFIC NEWS.

— Some interesting suggestions as to the evolution of the Vertebrata appear in Prof. Parker's Hunterian Lectures, recently reported in *Nature*. He recognizes "how thoroughly intermediate between the true reptiles and birds, the extinct birds of the chalk and the oölite were." As regards the mammals he says:

"Such a hypothesis as that nature had either all her birds or all her mammals from one stock is at once upset by the facts presented by the structure of the lowest mammals, the duck-billed Platypus and the Echidna. Between the mammals and the types which foreshadow them, viz: the Selachians and the Batrachians, there is unfortunately a large chasm, and, moreover, the Platypus and Echidna refuse to lie fairly in the direction indicated at the top of this chasm, or they confusingly partake of the characters of the reptile and bird; as well as those which are peculiarly mammalian * * * as already mentioned, the forecast of the mammalian type, which is very plain in the cartilaginous fishes, becomes much more plain, definite and indubitable in the frog and toad. In fact, the building materials are passed from hand to hand, as it were, in this way: the batrachian forefathers brought down all things meet for the work, borrowing and taking cartilages from the Selachians and bones from the Ganoids, and noiselessly forming them, after due selection, into a new, more compounded and noble structure. The rude ancestors of the tribes that give suck began to build on this higher level 'until the consummation was effected of vertebrate form.' But the consummation of all, the election and selection that has been going on since the beginning of the ages, is seen in man, who alone gives meaning to, and reads the meaning of, the whole mystery of organic life."

— From his recent studies on the habits of the cotton-worm moth, Prof. C. V. Riley concludes, in a paper lately read before the National Academy of Sciences, that the species is not represented by the egg, larva or chrysalis in the winter, but that the moth hibernates. His paper ends as follows: "My own belief now is that the moth really survives the winter in the more southern portions of the cotton belt, as on the Sea islands of Georgia and in parts of Florida and Texas, and that it is from this more southern portion that it spreads this year.

"This belief, which yet lacks full confirmation, does not preclude the occasional coming of the moth from foreign, more tropical countries, or the possibility of its being brought by favorable winds from such exterior regions; though the fact is established that it could not have come from the Bahamas since 1866.

"The question has an important practical bearing, for, on the theory of the insect's ability to remain with us, much important fall and winter work of a preventive nature may be done in destroying the moths; whereas on the theory of its annual perishing and necessarilly coming from foreign countries, no such preventive measures are left to the planter. The time employed in baiting and destroying the last brood of moths in autumn will be wasted, and he must helplessly await the coming of the parent the ensuing spring, and deal as best he can with the progeny."

— The papers read before the British Association at its last meeting, so far as reports in *Nature* and elsewhere show, comprised nothing especially noteworthy. The address of Prof. St. George Mivart before the Biological Section was on Buffon; that of Prof. Lankester was on Degeneration, an extension of some speculations made by Dr. Dohrn, while in anthropology the address of Mr. Tylor was interesting and useful. The meeting of the French Association was not characterized by any papers of a high degree of interest. The sixty-second meeting of Swiss Naturalists at St. Gall, was well attended, and Prof. Vogt, in a brilliant lecture, exhibited very good photographs of the second more perfect specimen of *Archæopteryx* found at Solenhofen, which, according to the report in *Nature*, "proves undoubtedly that we have to do with a bird-like reptile of the size of a pigeon, which had both scales and feathers, a beak provided with teeth, armed wings, bird-like feet with nails and a reptile tail consisting of twenty vertebræ." On the whole the Saratoga meeting of the American Association was characterized by apparently quite as able papers as those read at Sheffield, or Montpellier, or St. Gall. The British and French Associations made large grants for scientific research, an example which might be followed to better advantage to science by our association, than by printing a volume of transactions for gratuitous distribution, and maintaining a library, and paying office rent, and clerical assistance.

— Prof. Archibald Geikie is now delivering, in Boston, a course of Lowell lectures on earth-sculpture. He is well known in this country as the leading geologist of Scotland. He was appointed on the Geological Survey of Great Britain in 1855, and director of the Geological Survey of Scotland in 1867, and in December, 1870, to the new chair of mineralogy and geology in the University of Edinburgh, established by Sir Roderick Murchison and the Crown. He has written many important memoirs on geology and kindred subjects. He published the Story of a Boulder in 1858, and the Life of Edward Forbes in 1861; the Phenomena of Glacial Drift in Scotland in 1863; Scenery of Scotland, &c., in 1865; Memoirs of Sir Roderick Murchison, in two volumes, in 1874, with several elementary text books on geology and physical geography; articles in Quarterly Journal of Geological Society of London and other societies; in the Quarterly and North British Reviews. He has recently received a gold medal from the Royal Society of Edinburgh, for his memoirs on the Old Red Sandstone of Western Europe. He arrived in New York and started for the West August 12th, visiting the Yellowstone Park, Salt Lake, Wasatch and Uinta mountains, to study the glacial phenomena of those regions, returning East, Oct. 1st.

— The U. S. Geological and Topographical Survey, under the direction of Clarence King, has been fully organized, and has been

in the field of its proposed operations. It was the intention of Mr. King to devote the summer mainly to practical economic work, making as thorough an examination as possible of western mineral lands, and determining as far as practicable the nature, origin, geology, location and distribution of the various classes of ores. Mr. King's personal attention has been given mainly to the celebrated Comstock lode, in Nevada, and the central gold fields of California. He is assisted by Arnold Hague, late imperial minister expert for China, Mr. J. K. Gilbert, and Prof. F. V. Hayden. The specialists of the expedition in mining geology are Prof. Raphael Pumpelly, late of Harvard College, Prof. George F. Becker, professor of mining geology in the University of California, and Arthur Foot. The fields especially worked are, first, the metallic region of Colorado, centering at Leadville, in charge of S. F. Emmons, geologist, with A. D. Wilson as topographer; second, the lead-silver region centering at Eureka, Nevada, in charge of Prof. Becker, with F. A. Clark as topographer, and third, the Comstock lode and central gold fields of California, in charge of Mr. King, with the assistants previously mentioned.

— Dr. John B. Trask, at one time State Geologist of California, and who afterwards held a similar position in the State of Nevada, died in San Francisco on the 3d of July, at the age of 55. Dr. Trask was one of the founders of the California Academy of Sciences, and contributed many papers to the earlier volumes of its publications. Of late years he has followed his profession as a skillful medical practitioner, and will be remembered as a sympathetic and kind hearted man as well as a public spirited and useful citizen.

— The Visitors' Catalogue of the Museum of the Peabody Academy of Science, at Salem, Mass., is noteworthy not only from its neat appearance, but from its educational features, as the references to the specimens in the cases is preceded by a brief popular account of the different classes of animals, and with a sufficiently full list of articles and books contained in the libraries of Salem, referring to the animals, especially of Essex county. It is also provided with an index.

— The Seventh Annual Report of the Zoölogical Society of Philadelphia indicates the prosperity of this very successful project. The total excess of visitors over the attendance of last year was 76,966. On the 4th of July, 1878, 6,389 visitors were admitted. The floating debt of the society was reduced to from $20,500 to $9,000. There were at the time the report was made 826 vertebrates in the collection.

— A popular résumé of Prof. Mœbius' late work on Eozoön, a memoir in quarto with eighteen colored plates in the *Palæontographica*, has been published in *Die Natur* for 1879, Nos. 7, 8, 10, under the title of, Is Eozoön a fossil Rhizopod? It is illustrated

by twenty-one woodcuts, and is an interesting and, to some minds, will be a conclusive argument against the idea that Eozoön is of organic nature.

— The second part of Whiteave's volume on the Mesozoic fossils of the Geological Survey of Canada has lately been issued. It is devoted to a description of the fossils of the Cretaceous rocks of Vancouver and adjacent islands in the straits of Georgia, British Columbia. It is illustrated by excellent figures on ten plates.

— The Congrès international des Américanistes opened at Brussels September 23d. The object of the congress is to contribute to the progress of ethnological, linguistic and historical studies relative to the two Americas, especially before the time of Christopher Columbus.

— The Royal Society has issued a thick extra volume of the Philosophical Transactions (Vol. 168) containing a full account of the collections, botanical and zoölogical, made during the Transit of Venus Expedition of 1874–5, in Kerguelen island and Rodriguez.

— The tenth annual Report of the American Museum of Natural History shows progress in the increase of its collection, and especially in the deposits made of large and useful scientific libraries, which will tend to make the museum useful in advancing science.

— The Swedish Government intends to purchase the house and estate of Hammarby, near Upsala, which was the residence of Linnæus during the latter part of his life, and has appropriated for the purpose the sum of 80,000 crowns.

— There has been established at Messina a laboratory of maritime zoölogy similar to those already formed at Naples and Trieste, on the Mediterranean, and at Concarneau, Roscoff and Wimereaux, on the Atlantic.

— A recent paper states that smoke has lately been seen to issue from Mount Hood, Oregon. Is this statement correct; if so, will some of our Pacific coast subscribers send us information in regard to the matter?

— The director of the Central Park Menagerie, of New York city, reports 486 additions to the collection during 1878, the total number of animals exhibited being 1,060.

— The eminent coleopterist, Dr. J. L. Le Conte, of Philadelphia, has been elected an honorary member of the Societé Entomologique de France.

— The Sponges of the Gulf of Mexico have been elaborated by Oscar Schmidt in a work published in Jena.

ERRATUM.—In my notice of Prof. Smith's Stalk-eyed Crustacea of the Atlantic coast, p. 514 line forty, of the August number of this journal, for *Carcinus* read *Calcinus*.—*J. S. K.*

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We do not, however, find these expectations fully realized, for remains of ancient settlements are very rare, and no sure evidence exists of any long continued occupation of any locality in the immediate vicinity of the lake, and if a considerable population, with fixed settlements, ever lived there, it was long before the advent of the early explorers. In the writings of Champlain and others, we find intimations, in the quoted statements of the sav-

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THE region which surrounds Lake Champlain presents a very great variety in its surface features. As the tourist sails through the lake he may see, here lowlands, there mountains; on the one hand rocky hillsides, on the other meadows or marshes; here boundless forests, there wide and sparsely timbered plains, the whole intersected by numerous large streams and in the midst the lake itself, its northern portion filled with large islands, while south of these is open water. Such a territory must, if we can judge, have offered very great attractions to those savage tribes of red men who, in the early days before the white men began to encroach upon the lands they called their own, roamed through the forests or glided in their canoes over the water, for here they would find hunting grounds occupied by a great variety of game, surrounding fishing grounds of equal richness, fertile fields for the cultivation of the few vegetables which they used, and many a wild retreat in which they could conceal themselves from any powerful foe who should attack and defeat them. In such a region we should expect to discover many a site of an ancient village and great numbers of those stone implements which indicate the former presence of those who made and used them.

We do not, however, find these expectations fully realized, for remains of ancient settlements are very rare, and no sure evidence exists of any long continued occupation of any locality in the immediate [illegible] the lake, and if a considerable population, [illegible] ever lived there, it was long before the [illegible]ers. In the writings of Champlain and [illegible] the quoted statements of the sav-

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

APPALACHIAN MOUNTAIN CLUB, August 27.—A field meeting was held at Rev. Mr. Worcester's study, near the Intervale station, North Conway, August 27, when the following papers were read: Three days' walk upon the Great Range, by W. H. Pickering; The changes in the Saco meadow caused by freshets, by Rev. Henry A. Parker; Notes upon local names of the mountains, by Rev. John Worcester; Report upon some new paths, by Dr. W. B. Parker.

BOSTON SOCIETY OF NATURAL HISTORY, October 1.—Mr. M. E. Wadsworth remarked on Danalite, Picrolite and Picrosmine.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—July. The morphology of the vertebrate olfactory organ, by A. Milnes Marshall. On the brain of the cockroach (*Blatta orientalis*), by E. T. Newton. The microphytes which have been found in the blood, and their relations to disease, by T. R. Lewis. On the early development of the Lacertilia, etc., by F. M. Balfour. On certain points in the anatomy of *Peripatus capensis*, by F. M. Balfour (shows that the nervous cords are minutely ganglionated).

THE GEOLOGICAL MAGAZINE.—July. How the appearance of a fault may be produced without fracture, by W. O. Crosby. The slow secular rise or fall of continental masses, by K. Petterson.

August.—A cruise among the volcanoes of the Kurile islands, by John Milne. The surface geology of a part of the Mississippi valley (Iowa), by W. J. McGee.

THE CANADIAN NATURALIST.—July 30. Sketches of the past and present condition of the Indians of Canada, by G. M. Dawson. Some observations on the *Menobranchus maculatus*, by H. Montgomery. Address on disputed points in Canadian geology, by J. W. Dawson.

JENAISCHE ZEITSCHRIFT FÜR NATURWISSENSCHAFT.—July 16. W. Haacke on blastology of corals (bears on the general morphology, the radial and bilateral symmetry of corals).

AMERICAN JOURNAL OF ARTS AND SCIENCES.—August. Terminal moraines of the North American ice-sheets, by W. Upham. The loess of the Mississippi valley and the Æolian hypothesis, by E. W. Hilgard. Discovery of a new group of Carboniferous rocks in South-eastern Ohio, by E. B. Andrews.

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THE region which surrounds Lake Champlain presents a very great variety in its surface features. As the tourist sails through the lake he may see, here lowlands, there mountains; on the one hand rocky hillsides, on the other meadows or marshes; here boundless forests, there wide and sparsely timbered plains, the whole intersected by numerous large streams and in the midst the lake itself, its northern portion filled with large islands, while south of these is open water. Such a territory must, if we can judge, have offered very great attractions to those savage tribes of red men who, in the early days before the white men began to encroach upon the lands they called their own, roamed through the forests or glided in their canoes over the water, for here they would find hunting grounds occupied by a great variety of game, surrounding fishing grounds of equal richness, fertile fields for the cultivation of the few vegetables which they used, and many a wild retreat in which they could conceal themselves from any powerful foe who should attack and defeat them. In such a region we should expect to discover many a site of an ancient village and great numbers of those stone implements which indicate the former presence of those who made and used them.

We do not, however, find these expectations fully realized, for remains of ancient settlements are very rare, and no sure evidence exists of any long continued occupation of any locality in the immediate vicinity of the lake, and if a considerable population, with fixed settlements, ever lived there, it was long before the advent of the early explorers. In the writings of Champlain and others, we find intimations, in the quoted statements of the sav-

ages, that at one time the shores, especially the eastern, and the large islands of the lake to which he gave his name, were inhabited, but the savage allies of Champlain, who early in the summer of 1609 sailed through it, told him that because of hostilities between the tribes they were not then peopled, and this explorer did not, apparently, see any of the Iroquois who held the region until he reached a place which must, judging from his brief description, have been near what is now Crown Point. At this place, in May 1609, he joined his Algonquin allies in a battle with the Iroquois, and thus inaugurated the long series of conflicts which have made the place historic. Probably, further investigation will disclose some new facts, but at present we know of only two localities very near the lake shore where there are any sure evidences of continued occupation. One of these is on the shore, or very near it, at Plattsburgh, N. Y., the other is further from the lake, on the banks of the Missisquoi, one of the rivers emptying into the lake, near Swanton. Here and there on the large islands, and near the shore, large quantities of flint chips, or an unusual abundance of specimens, arouse a suspicion that there was located at one time a village, but the proof is wanting in all cases, though the probability may be strong. As we should expect from what we know of the condition of the tribes when first visited by white men, we find relics—and of many kinds, and in all a considerable quantity—not often in large numbers in a limited area, but scattered here and there over the country. Near the mouths of some of the larger streams, and along their banks, more are found than elsewhere, and there are some favored localities where diligent collectors have been rewarded with more than ordinary success, but after all, at least so far as Vermont is concerned, the above statement holds true. One of the most interesting localities, and one that probably affords us some of the most ancient specimens, is that already mentioned near Swanton. As a full account of this locality has been published in the Portland Volume of Proceedings of the American Association for the Advancement of Science, where some of the specimens are figured, I need only give here a brief statement of the leading facts respecting it. When Swanton was settled by white men a village of St. Francis Indians was located near the place, and many stone implements used by them have since been found. Probably most of the objects of this sort found on or near the surface should be referred

to this people. But another and more ancient people had also had a settlement near the same place, whose only relics, so far as we know, are such as they buried with their dead. On a sandy ridge near the Missisquoi, about fifteen years ago, an extensive pine forest was partially cut away. The trees, some of which had been growing perhaps for centuries, had hitherto protected the mobile soil from the prevailing winds, but after the clearing the sand was blown away until stone objects and fragments of bone were disclosed. My friend, Mr. H. H. Dean, of Swanton, together with others, thereupon examined the locality and discovered that where the old pine forest had stood, some unknown race had buried their dead, placing in their graves such objects as custom or affection indicated.

Between twenty and thirty graves in all have been discovered. A variety of objects have been taken from them, some of which were found directly beneath the stumps of large trees. These objects differ materially from those which belonged to the Algonquins, being of finer material and more excellent workmanship, and most of them closely resemble similar specimens from the mounds of the Mississippi valley, many being identical. In all cases except two the sand about the bodies was colored a dark red, probably by some mixture of red hematite and water, and some of the stone implements are stained with this same substance. The skeletons in the graves were mostly decomposed, so that only few and fragmentary bones have been preserved. A few objects made of native copper beaten into shape were found, such as chisels, small bars, and beads made of sheet copper rolled into tubes. Shell beads almost precisely like some of those figured by Mr. C. C. Jones in "Antiquities of Southern Indians," have been found in considerable number. Of stone implements and ornaments a much greater number were found; of these, perhaps the most interesting are stone tubes, of which about a dozen have been obtained. These are all of similar form, being cylindrical, the perforation, at one end about half an inch in diameter, enlarges to nearly an inch in diameter at the other end. They are of smooth, hard stone, of a drab color in some specimens, brown in others. They are very nicely formed and finished, the surface being smooth and almost polished. The small end of the bore was stopped somewhat imperfectly by a stone plug ground into shape. The length of the tubes varies

from seven inches to thirteen inches. Similar tubes have been found on one of the islands in Lake Champlain and near Burlington, and Mr. S. L. Frey, of Palatine Bridge, N. Y., has described[1] very similar ones from graves at that locality. And in most respects the graves which Mr. Frey has discovered resemble those found in Swanton to a very remarkable degree. Several gorgets, or two-hole stones, some of them made with great skill, have been found in the graves, and other objects which may properly be classed with them, viz: boat-shaped stones and two carved bird-like heads. All of these are made from ornamental stone, and are carefully finished and perforated, at each end of the base in the heads, and each side of the middle in the boat-stones. It is worthy of note how large a proportion of the objects which were buried in these graves are ornamental in their character, or at least of a higher grade than the ordinary axes, spear, arrowpoints and the like. Although specimens of these have been found, they do not occur in large quantities, and they do not, as is usually the case, make up the greater part of the collection.

In North-eastern Vermont there were settlements, formerly of the Coosuck Indians, a branch of the Abenaqui, and near what is now called Wells river, remains of a village and fort were visible not many years ago. So far as my observation extends, that portion of Vermont west of the Green mountains was more thickly settled, or perhaps it would be more correct to say more frequently visited than the eastern portion. As all the specimens are obtained in such a manner as to preclude the possibility of fixing even their relative age, this cannot be definitely determined, but I am clearly of the opinion that, while probably a large part of the objects found are to be considered as having been made and used by the Iroquois or Algonquin tribes, there are others of a more elaborate pattern, showing greater skill and taste, which are to be referred to a more ancient and unknown people. I wish to give a general account, necessarily brief and imperfect, of the several kinds of objects found in that part of Vermont and New York which may be properly included in the Champlain valley. Copper articles are rare and all are of, presumably, Lake Superior native copper beaten into the required form. More copper specimens have been found in

[1] American Naturalist, Vol. XIII, p. 637.

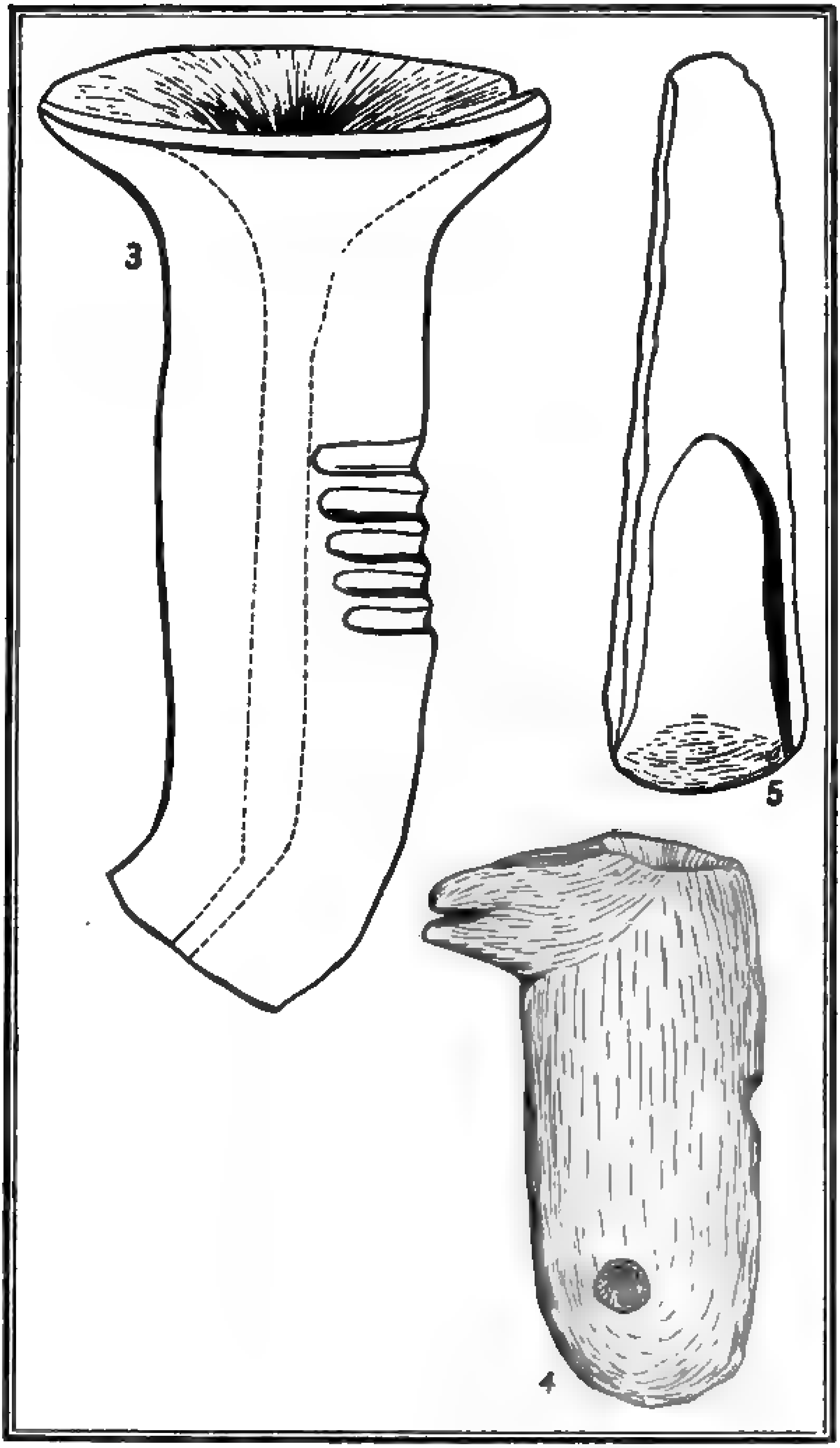

PLATE I. Perkins on the Archæology of Vermont.

the Swanton graves, as incidentally noticed above, than in any other locality, but other articles, one here and another there, have been found in various places. A very fine copper gouge was found near Milton and is in the collection of Mr. P. C. Deming of that place, who has a very fine local collection. This is shown one-half full size in Fig. 5. Spearpoints, occasionally with notched stems or with the sides of the stem turned over to form a socket, also occur sparingly. These, together with the articles already mentioned in connection with the Swanton graves, complete the list of copper articles. No objects made from shell except the shell beads from Swanton have been found.

Specimens of earthenware occur all over the State, chiefly in the form of fragments. The only entire specimens of jars now in existence, are two in the college collection at Burlington. Several others have been found but have been destroyed. Both of the entire jars are figured in Vol v, pp. 14, 15, of the NATURALIST, though Fig. 2 is not entirely correct in its representation of the rim. As I have given a detailed account of some of the more prominent kinds of Vermont pottery elsewhere,[1] it must suffice to give here only general statements. All of the earthenware was ornamented somewhat, some but little, some more, the decoration consisting of impressed figures of a great variety of form, as squares, circles, triangles, crescents, key-shaped figures, etc., with lines of greater or less width running either horizontally, obliquely or vertically. These are combined to form a great diversity of patterns. Some of them, as may be seen by a reference to the figures mentioned above, are very elaborate. No decoration by the application of paint or any coloring material occurs. In most cases the ornamentation is confined to a narrow band around the rim, and I believe in all cases the lower portion, which was globular, was smooth. The mouth of the jars was usually circular, but sometimes rectangular, becoming circular at the contracted portion, or neck. In no case was there any attempt at imitation of animal forms. The material of which the jars was made is essentially like that found elsewhere. In some cases it appears to have been gravel mixed with clay, as the fragments of quartz and feldspar are rounded, in other cases the fragments are angular, and were obtained by pounding; fine sand seems to have been used in some cases. In color there is as great

[1] Proc. A. A. A. S., Vol. xxv.

a variety as in texture, some pieces being light stone color, others black and others of intermediate shades. The smallest jars are only known by fragments. From these, so far as we are able to reconstruct the jars, we judge that they held about a pint. The largest jar is one mentioned in Thompson's "Vermont." This was found in Middlebury, and held twenty quarts, but I can not discover what has become of it. The two jars in the museum at Burlington hold, respectively, nine and twenty-four pints. A few fragments of pipes have been found made of terra-cotta. Mr. Deming has, in his collection, a perfect specimen of very fine material of the form which resembles a trumpet, much like some figured by Schoolcraft.[1] The Milton pipe, Fig. 3, is of very fine form, of a reddish-brown color, smooth and polished on the surface. It is about four and a-half inches long, nearly straight except at the smaller end, which is abruptly bent down, and at this point the bore is but an eighth of an inch in diameter, though it is twice as large throughout most of the length, and at the large end, which is two inches in diameter, it expands to nearly the same size. Across the middle portion of this pipe are five transverse grooves, which extend about half way around the body. Dr. Kellogg of Plattsburgh has a fragment of what appears to have been a very similar pipe from the New York shore of the lake, and some of those figured by Schoolcraft were found in that State. In the abstract of a paper read at the St. Louis meeting of the A. A. A. S., and published in Vol. 27 of the "Proceedings," I stated that no agricultural implements had been found in Vermont. Very soon after making this statement I found undoubted implements of that character, and while they are by no means abundant, they are certainly not absent, for I have seen quite a number, nearly all of them spades, although one or two may have been used as hoes. None of the specimens exhibit the regular oval form of western specimens, but all are more or less narrowed at one end, and are generally lanceolate or leaf-shaped. Nor do they equal the best western specimens in regularity of outline and elegance of finish. They are all of flint or hornstone, flaked, and are usually strong though all are not clumsy. The largest are about ten inches long and four inches wide, while the smallest may not be half so large. It is not unlikely that agricultural operations may have been carried on by the aid of other implements than those usually assigned to

[1] History, &c., of Indian Tribes, Part 1, pls. 8 and 10.

that use, and many specimens of celts, ungrooved axes and the like may have served a good purpose as spades or hoes. Some of the specimens found in Vermont, which from their form would be classed as celts, are of soft material and of a character such as to render it very probable that they were used for digging rather than cutting. If this be so, agricultural implements may be more abundant than has been supposed. All the ordinary varieties of axes and hatchets have been found about Lake Champlain, by far the most abundant being celts, or ungrooved axes, and because of their great diversity in size and form, I am led to believe that these implements may have served many different purposes. Indeed it would not seem very improbable that the same implement may have served at one time as a tomahawk, at another as an axe or chisel; or, with a different handle, even as a spade or hoe. Forming a sort of connecting link between the celt and the grooved axe is the notched axe. Most of the specimens of this class are small, but a few quite large ones have been found; most of them are rather rude and of coarse material. Grooved axes are not common, though some few very fine specimens have been found, but I have seen none that would compare favorably with the finest Western specimens either in size or elegance of form. The largest which I have seen is nine inches long and four and a-half inches wide, but most of the grooved axes are much smaller. Such specimens of axes as have been collected have been obtained, one here and one there, singly, nowhere in such groups as some collectors describe. I presume that all the grooved axes ever found in the Champlain valley, unless many were destroyed before collectors began to save them, would not amount to so large a number as Dr. Abbott mentions from a single small excavation made in digging a cellar in Trenton, N. J. Hatchets, chiefly of flint, are found, some of them with very sharp edges and regular form. One very unique specimen of axe, if such it is, should be mentioned here. It is in the possession of Mr. W. W. Culver, of White River Junction, and was found near that place; its form is that of a letter L, somewhat like one figured by Evans[1] which was found in England, but the Vermont specimen is much larger. It is shown about one-fourth natural size in Fig. 6. The longer arm is seven and a-half inches and the shorter four and three-quarters inches long, and both are

[1] Rude Stone Implements, p. 124, figure 82.

about two and a-half inches wide; it is made from basaltic rock; one surface is flat, the other convex. The edges are rounded, well made and sharp.

Specimens of "pestles" are often found, though whether all of them were used as implements for pounding grain seems more than doubtful. In our collection we have three which I should hesitate to call pestles. One of these, especially, seems unfitted for such use, but rather seems to have been made for a baton of office, or a club. It is shown about one-half natural size in Fig. 1 and is twenty-seven inches long, quite slender, and uniformly cylindrical, its average diameter being about two inches. Its weight is six pounds. The diameter is nearly equal throughout; one end is somewhat contracted, and the opposite more so to form a neck for the carved head which terminates it. This carving, though not elaborate, yet distinctly and strongly indicates a head, somewhat dog-like and somewhat fish-like, in some features resembling one animal, in others the other. There are no ears, but the eyes are large and prominent. The muzzle is much elongated, the whole length being over three inches. The mouth is represented by a deep groove extending back on each side as far as the eyes. From the lower lip a raised ridge runs back and over the top of the head, which resembles somewhat the gill-cover of a fish. The material is a gray schist well finished, and where the surface is not weathered it is smooth. This specimen was found near the lake shore not far from St. Albans. Another very similar specimen, but without the carving, has recently been found on the New York shore. Another specimen of this sort, with a somewhat similar carving, though shorter and thicker, is made of hard red sandrock, such as occurs abundantly in this region. This specimen, though of about the same diameter as the preceding, is only half as long, and the diameter is not so uniform, but increases from the carved end to the opposite, which is rounded unevenly. A third and still different specimen was found near Highgate, Vt. This is a little less than twenty inches long and made of fine-grained gneiss. It is not cylindrical, but oval in cross section, the surface being well smoothed, and it appears to have been at first rectangular in cross section and made oval by rounding the corners. The surface was first picked and then ground so that most of the marks of the pick are removed. The carved end represents, rather rudely but yet

plainly, the head of a squirrel or some similar animal. All of the above carvings are somewhat oblique with reference to the main shaft of the specimens. I have heard of a similar "pestle" with carved end in the State collection at Albany, but I have not seen it. May it not be that these articles were either clubs or for some similar use, the carving indicating the totem of the owner?

Of the more common forms of "pestles," we have found in Vermont, I believe, all varieties. Some are fusiform, used, evidently, as rollers, since both ends are in some cases polished by the friction with the hands, others as obviously used for pounding, as the more or less rectangular form precludes the possibility of rolling them; one of these is three inches square and nearly a foot and a-half long, flat on all sides; other specimens are flat on two sides and rounded on the other two; others are club-shaped, and so on.

Pipes are rarely found; in all I know of no more than six perfect specimens, though others may be in existence, and probably others have been found and destroyed. All of those which I have seen are well made, and polished, and while, as compared with the elaborately carved specimens from the mounds, our Vermont specimens appear very plain, yet they are not of inferior workmanship though simpler in form. Only one specimen exhibits any attempt at imitation of animal form, and this not to a very high degree. It is prolonged on one side of the rim to form what appears to be the beak of a bird. The form of this pipe, Fig. 4, is cylindrical, with an aperture for the stem about half way between the rim of the bowl and the base, and transversely to this there is another hole through the base as if for suspension when not in use. It is over two and a-half inches long, and rather more than one inch in its longest diameter, the cross section being oval. It is made of a compact, gray, mottled limestone, well polished over the outside and on the inside of the bowl.

Another pipe of somewhat different form, made of black limestone, was found on an island in the lake. This is well polished, the upper part cylindrical, or rather urn-shaped; below this there is a narrow rectangular space, and below this it is contracted and wedge-shaped. The lower end is deeply notched. It is larger than the preceding, being three and a-half inches long. The bowl is very well made and, as in the former specimen, the stem enters at the side near the middle. Another pipe of dark clouded gypsum, highly polished, is in general form like that of a modern clay pipe. This is described in Vol. v, page 13, of the NATURALIST. Others I will not take space to describe.

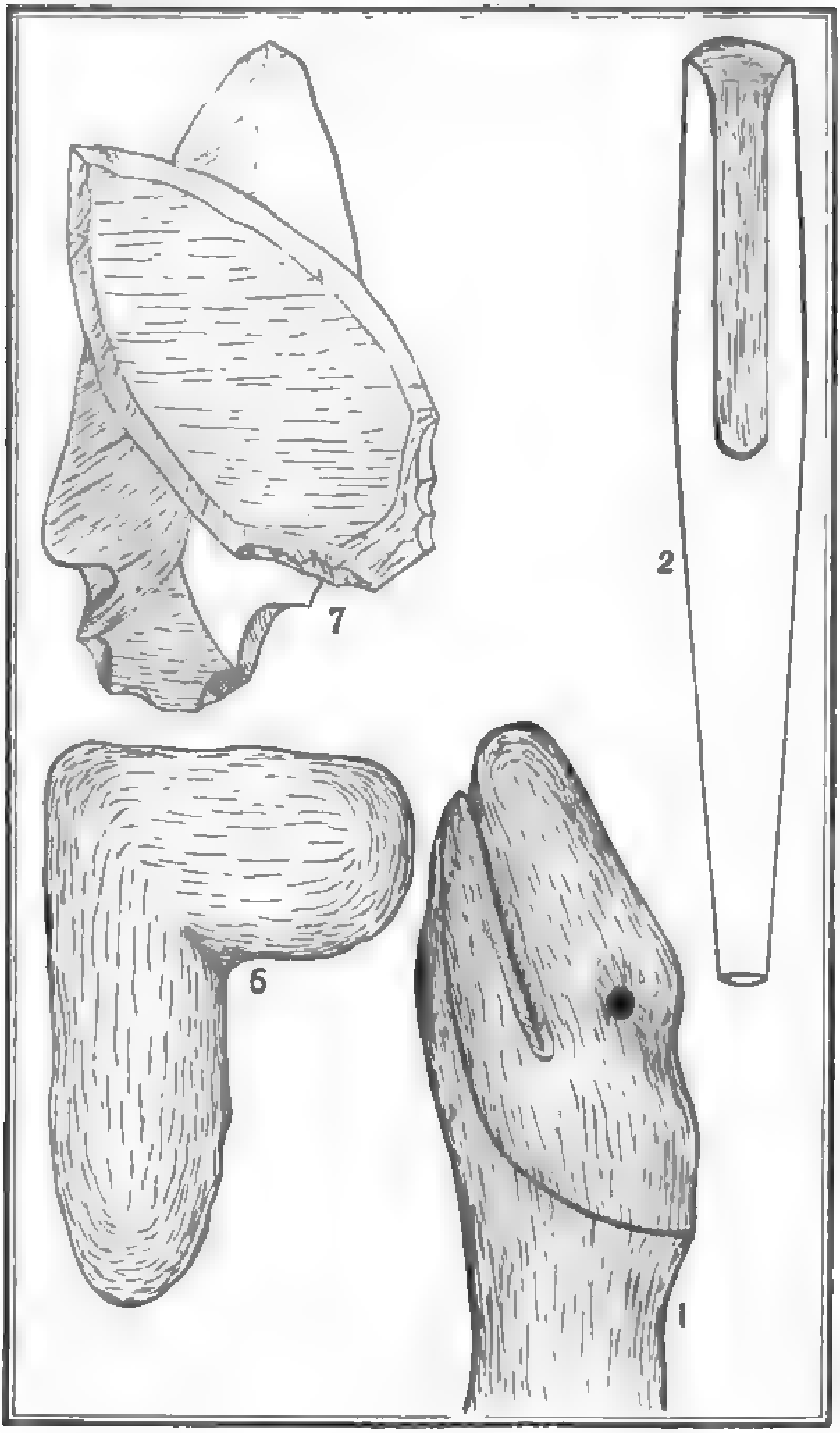

PLATE II. Perkins on the Archæology of Vermont.

Gorgets, with one hole or two, are found all over the region we are considering. As is the case elsewhere, these are usually made of some compact, fine-grained stone that is capable of taking a smooth polish. Slate is the most common material in those that I have seen, sometimes red roofing slate, often a dark-greenish talcose slate veined with black. The gorgets with one hole are less common and less elegantly made than those with two, and the material seems less carefully selected. Of the two-hole stones, those of rectangular outline are most abundant, not that all these are rectangular, but with some modification of this form, as with corners cut off making an octagonal figure, or rounded more or less. In these, as in the banner stones, we find, in Vermont, many specimens closely resembling those found in the Mississippi valley. A greater range was possible in the choice of material of which to make "banner stones" for, as they are often thick, a material which would readily cleave into thin flat pieces was not essential, as it was in case of the manufacture of gorgets. Accordingly we find the banner stones made not only of slate, like that of which the gorgets were most often made, but also of limestone, greenstone, syenite, &c. With one exception, and perhaps that was for a different purpose, all the banner stones are perforated, sometimes by a hole of considerable size, and the regularity which we find in the perforation of very hard stones is often very remarkable, as is also the finish of the entire specimen.

The "boat stones" alluded to in speaking of the Swanton graves are also found in other places, though nowhere common. Some of these are deeply excavated on the upper or flat side, others but very slightly or not at all. In the selection of material for the manufacture of the different classes of what are considered ornamental articles, some principle was adopted which we cannot understand, for while stone that was attractive in color was used, much that could easily have been obtained and that would have made, so far as our judgment goes, much more beautiful objects, was neglected. For example, in many places on the shore of Lake Champlain, a fine black slate conspicuously veined and clouded with pure white satin spar abounds, and everyone is familiar with the fact that a great variety of marble is abundant in Vermont, and much of this crops out on the surface and could have been easily obtained, but when we search in collections of archæological objects for specimens made of these materials, we

search almost in vain. With the exception of one of the carved heads mentioned above, which is of white marble, I know of no specimen made from any of the kinds of stones mentioned. As a general rule, I think that the stone implements found in the Champlain valley are made of less beautiful material than those from the Mississippi valley, so that if we could see collections of similar objects from each locality side by side, there would be a noticeable difference in brightness and variety of color. This is especially true when we consider only those objects made of the different varieties of siliceous stone. It is not altogether owing, it may be, to any lack of taste in the selection of material for making arrow and spearheads, but to the fact that the kinds of stone conveniently accessible to the New England tribes, which were suitable for flaking, were fewer and less beautiful than those found in the West. Occasionally jasper or agate, or some attractive bit of stone was brought from Lake Superior or the Mississippi, and specimens made from such imported material are at once conspicuous in a collection on account of their greater beauty, but ordinarily the less brightly-colored materials, the gray quartzites, dull brown or black hornstones, and bluish or milky quartz, such as could be taken from ledges near at hand, furnished the staple for flaked articles, while pebbles from the drift somewhat increased the variety. Fine grained flint, prettily veined jaspers and agates are not wanting, but quartzites were largely used, and our collections lack much of the beauty which we see in those from other localities. Nevertheless some of the milk-white quartz specimens are very pretty, and one of the most commonly used materials, a translucent, bluish quartz, is, in fine specimens, by no means destitute of beauty.

So called "gouges," though not among our most abundant specimens, are yet relatively quite common, and of an almost endless variety of form. That all of these grooved implements were used as gouges is very doubtful. Of some of the specimens I have found it impossible to do more than conjecture the use. None of the objects found are more carefully formed or finely finished than some of these "gouges," and most of them are far more carefully made than the "chisels" or celts. Some of the larger specimens are a foot in length, of basalt or other hard stone, but yet are made with a degree of skill, as exhibited in the symmetry of form and smoothness of surface, that excites

great admiration. In some the groove is wide and deep, and reaches from end to end, each end, in some cases, being ground to an edge, in others it is short. Some are flat on both sides, others on one, others convex on both. Some have one end finished like a gouge and the opposite like a chisel, and in these the gouge end is flatter than usual and the excavated portion but little concave. Some are of such soft material, as steatite, that it is difficult to see how they could have been of much service as implements, but most are of hard stone. Several long "gouges" have been found which are somewhat peculiar in form. All of these are very finely made; in cross section they are shaped like a narrow Gothic arch, the point coming opposite the groove, or, in such as have only a short groove, the portion above this may be nearly cylindrical. Fig. 2 shows a very fine specimen of this sort which is over a foot in length. It is made of a rather hard greenish stone and is elegantly formed and polished. It is in the collection of Hon. A. B. Holbert of Essex, Vt. One of the largest of these specimens is in the collection of Dr. Kellogg, of Plattsburgh, and is eighteen inches long, with the end opposite the edge broken off, so that its entire length was probably considerably more. The groove extends through the entire length, and presents the unusual feature of being larger above the edge than just at it; the material is basalt. Another specimen, found not far from Burlington, less elegantly made and more clumsy but yet a very fine specimen, is nineteen inches long.

The different classes of chipped or flaked articles, as scrapers, rimers, knives, hatchets, spear, lance and arrow points, are found in greater or less abundance on the shores of Lake Champlain. Scrapers, similar to those found elsewhere, occur, though rather sparingly. The smaller ones are oblong, oval or nearly circular, while the larger are more triangular or lanceolate. Some of the discoid scrapers are very small, but the abruptly beveled edge is carefully chipped, and their use can scarcely be doubted, although similar disks of flint or quartz, half or three-quarters of an inch in diameter, are found, which have no such edge. Sometimes chance flakes, chipped off in making some other and larger object, have been by a little labor converted into scrapers. Some large specimens occur which have a less decided scraper edge, and may have been skin dressers.

Of knives we find many interesting specimens, exhibiting, I think, more than the usual variety of form. All that have been found on the eastern shore of the lake are chipped or flaked, but, as will be seen hereafter, ground knives have been found on the western shore. In the examination of our specimens I have often found it difficult, and sometimes impossible, to decide whether a given specimen was to be considered a knife or a lance, or a spearhead, for the "knives" pass, by indistinguishable gradations, into several other classes of implements. Moreover, I cannot doubt that often the same implement was used at one time without a handle as a knife or skin dresser, and at another fastened to a shaft as a spear or lance. Some of our Vermont knives are quite rude, others are more elegantly formed and finished, but none of them present so finished an appearance as some of the ground knives from other localities. The common oval knife with a sharp edge all around it is often found, and of various sizes, some being less than an inch in diameter, others several inches; other knives are ovate, triangular, lanceolate, linear, and many more or less irregular modifications of these forms. All of these are without stems, and most of them undoubtedly knives, used for no other purpose than cutting. Some are edged on all sides, others on only one; some are several inches long and not more than one wide, making dirk-shaped implements.

It is interesting to notice that on both shores of Lake Champlain we find the same quadrangular forms, broken across one end, as those figured by Dr. Abbott in his "Stone Age in New Jersey,"[1] and from the appearance of our specimens I am inclined to agree with him in believing that the break was not accidental, or rather, I should think it more probable that the broken end is simply the original surface of the block of flint or quartz from which the knife was flaked, and while all the other sides were chipped, this was left, perhaps for insertion in some sort of a handle of wood or bone. Stemmed or hafted knives of many forms occur abundantly all over this region, some of them shaped much like a modern knife, others more like lance or spear points, and I do not think that any definite line can be drawn between these classes of implements. In Vol. v of this magazine, p. 16, Fig. 5, a very peculiar form of what I then called a spear point, is shown about half natural size. At the time the article was written, this specimen was the only one I had ever seen, but since then several

[1] Smithsonian Report, 1875, p. 301, figs. 111, 112.

others have been found of similar character. If these specimens are to be considered as implements at all, they are better fitted for use as knives than as spear points, and on this account I will mention them here. So far as I can ascertain, no specimens of this sort have been found elsewhere, but they occur on both the Vermont and New York shores of the lake, though none have been found far from it. Of the dozen specimens which have been found, no two are alike in form or size, but they all resemble each other in being made of slate, usually red roofing slate, ground, not chipped, and with the stem notched on each side by a series of semicircular depressions. In some specimens the notches are small, in others large; one specimen having but two deep and wide notches on each side of the rather short stem, while another has five smaller ones. As has been said all are of slate, those not made from roofing slate are of drab talcose slate, except one which is of a compact mica slate. In some the surfaces are flat, beveled only near the edges, which are straight and sharp in all, while in others the whole surface is beveled from a median line. All are very regularly and finely formed; some are smooth, others show marks of grinding. Most are more or less ovate-triangular in outline, but one or two have nearly straight and parallel sides, except near to the point. Two of these specimens are shown full size in Fig. 7, but the figure does not fully represent the regularity of form of the original. One or two are so long and narrow that they seem wholly unfit for any use as implements, one especially, made of talcose slate, is nearly nine inches long and one and a-half inches in width at the base, the average width being much less. Such an implement would break with very little rough usage. The other specimens are smaller and stronger, but none would long remain intact if subjected to much hard treatment. Most of the specimens are from two and a-half to three inches long, some being a little less, some more than this. The width varies less, most of the specimens being very nearly an inch and a-half at the widest part. One or two specimens have been found which were precisely similar to those described except that the stem was without notches. None of the specimens show decided indications of having been used, and most are as fresh in appearance as when first made; this fact, added to the great weakness of some, and lack of strength in the material of all, leads me to conjecture that they may have been badges of office or something of the sort, rather than for any definite use.

Rimers and drills of the usual forms are found, though not in great numbers. Most of the perforations found in various specimens, as banner stones and tubes, were not made by means of flint drills, but by sticks of wood, or perhaps hollow reeds and sand, or some such process.

Spear, lance and arrow points are of course more abundant than any other class of specimens, and all the varieties figured by Col. Foster are found, with others differing from these. Some very singular inequilateral forms occur, like those figured by Prof. Haldeman in a recent number of the NATURALIST, and many others. Indeed a close examination of any large collection of flint points, will show that entirely symmetrical forms were rarely attained; by far the larger part are more or less unequal, both as regards curvature or straightness of the edge and convexity of the surfaces. One edge is usually more strongly curved than the other, and one surface more convex than the other. Often the blade is not in the same plane with the stem, but seems twisted upon it, due, as I think, less to the intention of the maker than to the fracture of the stone. From these slightly, often almost imperceptibly, unequal points, we have every gradation to those which are nearly as unsymmetrical as possible, and of these latter, some are so well chipped that I cannot regard them as "failures," but for some unknown reason intentionally of the form we find them. In comparing the specimens from the Champlain valley with those from Georgia, figured by Mr. Jones, I have been struck with the close resemblance between them; there are comparatively few of the objects described in "Antiquities of the Southern Indians," which cannot be duplicated, often exactly, in Vermont specimens. This resemblance is more noticeable because among Dr. Abbott's New Jersey specimens I find many unlike those which we have with us.

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THE ORIGIN OF THE DOMESTIC ANIMALS.

BY G. DE MORTILLET.[1]

WE know that the men who lived in our region during the long quaternary, or paleolithic period, were autochthones. We have seen that they developed slowly, regularly, in a progressive, continuous manner, both from a physical as well as an

[1] Translated from Materiaux pour l'Histoire primitive et naturelle de l'Homme, 1879. 4e et 5e livraisons.

industrial point of view, from the beginning of the quaternary up to the present (actuelle), or neolithic epoch. During all this vast lapse of time nothing happened to interrupt the two-fold, ascending, progressive movement; nothing has seemed to disturb it. No new element has been suddenly added. This movement has, then, operated in the local, autochthonous population without intrusion and mixture of foreign populations.

At the beginning of the present epoch, on the contrary, we see all at once a new civilization introduced without transitional steps. The neolithic, or polished-stone, industry, to which I have given the name of *Robenhausienne*, appeared all at once without the least gradation, and at the same time we find a new human type, the brachycephalic type. There was here an invasion. A population from abroad brought here all at once not only the polished hatchet, which is only a single fact, but also, and what is especially noteworthy, pottery, domestic animals, the cereals, monuments, dolmens and menhirs, and finally, religious ideas, the worship of the dead. All this was completely unknown to the autochthonous population of geological times, to the paleolithic people. We see that with the polished hatchet appeared six domestic animals, the dog, goat, sheep, ox, horse and pig; three cereals, wheat, barley and rye, accompanied by a textile plant, the flax. It is evident that there took place an industrial revolution which corresponds to that produced in America by the arrival of the Europeans. It is incontestably the fact that here was a great invasion—great at least from the point of view of the results produced. It was the first which took place in Western Europe.

Whence did this invasion come? The study of the domestic animals may tell us. We need not urge the case of the dog, which may have preceded the arrival of the invaders. Indeed, it is the animal the most anciently and completely domesticated. Of all the domestic animals, it is the only one which man has not been obliged to care for and watch. We may say, on the contrary, that he watches man. Very valuable from the two-fold point of view of personal necessity and of the chase, it was held in high esteem by the savage and nomadic peoples who were always on the *qui vive* and lived only by the products of the chase. In fact, the dog is, in our day, quite what he was among the people who had no other domestic animals. We may now say some words as to his origin.

Some authors have derived the dog from the fox. This view is not probable, because there exists in the fox a particular disposition which is not found in dogs.

It is said also that the dog has descended from the wolf or jackal. This is possible, but is not probable; wolves and jackals do not voluntarily breed with dogs.

We meet in the quaternary beds and deposits of France with the remains of a species of Canidæ more nearly allied to the domestic dog than to the wolf or fox. But these remains are rare, wholly exceptional in our region. If this canid has given origin to some one of our domestic dogs, which is possible, this could not have occurred in our country. This event happened when the quaternary canid was in its own country, where it abounded and lived in continual contact with man.

Among savage animals which may have given origin to the domestic dog are found the *colson* and *buansu*, veritable wild dogs. They actually inhabit the regions of India situated between the Lower Himalaya and the coast of Coromandel. They are perhaps the emigrated descendants of the quaternary canid of which I shall speak presently, and indeed they have close osteological resemblances.

Our actual races of dogs are so numerous, so varied in form, so different that very probably they have had different origins. Certainly there is one which has come from the *cabéru*, the wild dog of Abyssinia, which has been found as far as the center of Africa. Certainly one of the oldest races of dogs in Egypt is the domesticated *cabéru*. Indeed, on the Egyptian pictures which go back to the remotest periods, to the fourth and even to the third dynasty, that is to say from 3000 to 4000 years before our era, we have seen certain large greyhounds. Indeed, the *cabéru* is extremely near the greyhound.

But we will not speak farther of the dog. The five other domestic animals which we have seen to have appeared in Western Europe contemporaneously with the polished hatchet and with pottery are, the horse, ox, goat, sheep and pig.

Since all the animals have had quaternary ancestors in our region, they have therefore been supposed to have been domesticated by us. Certain naturalists, indeed, assume that this has been the case. An attentive study of facts contradicts this assertion. The domestic animals appeared all together, contempora-

neously, associated with a totally new civilization which arrived simultaneously. They were, then, imported, like the civilization which they accompanied. They were not, therefore, domesticated there as indigenous products, but foreign products introduced into the country by new arrivals, by invaders.

This general proof of the non-indigenous domestication is corroborated by the study of details. If, at the quaternary epoch, the horse, the ox, the goat were ancestral representatives in all France, it was not so with the sheep. In our quaternary deposits it has only occurred on the Mediterranean shore. It has been found in Hérault; it is abundant at Menton. This is evidently the northern limit of its habitat, and consequently this cannot be its place of domestication.

The fact is still more explicit as regards the pig. In the Robenhausian, or polished-stone epoch. we have recognized two species of domestic pigs in France, in Switzerland and in Italy. To the ordinary pig which originated from the wild boar, an animal abundant in our quaternary deposits, may be added the turf pig, very different, which has no other ancestor in the countries which I have just named. To learn where the domestic animals have come from, we should take into account the geographical area of their savage ancestral types. At the quaternary epoch the wild horse, identical with the domestic horse, was extremely abundant, not only in Western Europe but also in Asia Minor, on both slopes of the Caucasus and over all the basin of the Caspian sea. It extends still farther to the east. Its area of habitation traversed Europe and Asia.

The wild quaternary ox had a habitat a little less extended than the horse; nevertheless, like the latter, it extended from our region very far into Western Asia. Without speaking of the species with the hump, like the aurochs, there were two types of true oxen, the urus, of very great size, and another ox of much less size. Our domestic oxen certainly originated from one of these two types, perhaps from both.

The domestic goat may likewise have been derived from the bouquetin of the Alps and of Spain, as also from the *égagre*, the bouquetin of Crete, of Southern Caucasus, of Armenia and of Persia. Bouquetins and égagres breed spontaneously with the goat and produce very readily fertile hybrids, which proves that there exists between them strong bonds of parentage.

The sheep is a transformation of the mouflon of Corsica, of Sardinia, of Cyprus, which joins in the east, by Asia Minor, the argali sheep (mouflon) of Grand Tartary.

Finally, the ordinary pig is evidently a modified wild boar. Indeed, our pig set at liberty assumes the characters of the wild boar, and the latter, raised like our pigs, end by resembling them. Like the horse, or the ox, the wild boar ranges from Europe to Asia. Moreover, it is only in Asia that we find wild another swine, which is allied to the turf pig.

The only country containing all the ancestral types of domestic animals introduced into Western Europe at the Robenhausian epoch is that part of Asia which extends between the Mediterranean, the Grecian archipelago, the Black sea, Caucasus, the Caspian sea, the limits of Afghanistan, the north of Persia and Assyria. We should conclude that it is from that region that has proceeded the great wave of migration which has brought us, with the civilization of the polished stone epoch, our first domestic animals.

The study of cultivated plants confirms the facts deduced from the study of the animals. The invaders of the west of Europe, which at the Robenhausian epoch brought us the domestic animals, also introduced to us the three cereals, wheat, barley and rye. It is an agriculture transferred, transplanted all at once, and which consequently has not taken birth in our regions. The three cereals which I have just cited have had no ancestors among us. Among all the wild grasses, which have been well studied and are perfectly known, none approach the wheat, barley or rye. We are ignorant, it is true, of the ancestral forms of these three cereals, nevertheless, botanists are quite generally agreed that they came from the Caucasian regions. A certain fact, which militates in favor of this opinion, is, that the cereals named, whenever they have been cultivated in our fields, sometimes leave sporadic or spontaneous descendants; but they soon disappear at the end of two or three years and are no more to be seen. In the Caucasus, on the contrary, these sporadic and spontaneous individuals, escaped from cultivation, perpetuate themselves for a series of several years, besides that, they are generally more frequent. This proves that there they are nearer the place of origin, if that be not the place of origin itself.

With the wheat, barley and rye the Robenhausian invaders

brought us a textile plant, of which they made great use, *i. e.*, flax. This plant is most useful in determining with precision the point of departure of the Robenhausian civilization. This civilization did not come from North-eastern Asia; for in China they have the hemp, a textile plant much more useful than flax; but the hemp was completely unknown in Western Europe during the entire polished stone epoch.

Flax also was very widely spread in ancient Egypt, to the exclusion of hemp. It can perhaps be inferred from this that the civilization which we have studied has come from Egypt, or at least from South-western Asia. To recognize the slight foundation of this assertion it suffices to return to the domestic animals. We have seen that the great migration of the Robenhausian or polished stone epoch brought us the domestic horse. However, the domestic horse, far from having originated in Egypt, was not introduced into that country until after the time of the pastoral kings, at the beginning of the eighteenth dynasty, in the eighteenth century before our era. The first domestic equid of Egypt was the ass, an animal of African origin. But the ass did not occur at all in Europe during the stone age. This absence of the ass, a very useful animal which lives very well in our climate, is also a proof that the civilization of the first great European migration did not come from South-western Asia, which has wild horses allied to the ass, such as the onager, which inhabits the shores of the Indus and extends to Southern Persia; or the hemione of Upper Asia and Mongolia. Everything in the study of the domestic animals and cultivated plants concurs, then, to prove that the first great migration which entered the south-west of Europe, at the Robenhausian epoch, came from Asia Minor, Armenia and the Caucasus. From our actual knowledge, we cannot establish whether this migration has followed the route of the land or even the course of the sea; but this much is certain, that in either case it reached us by the Mediterranean basin. If, without pastoral and agricultural facts, we seek proofs of this fact, we shall find in it the retrograde artistic movement, and in the introduction of architecture or the appearance of a monument, the *dolmen*.

The last populations of the geological periods, that of the Magdalenian epoch which terminated this period, had a very pronounced artistic sentiment. We have found in France, in Switzer-

land, in Belgium and in England, in the deposits of this epoch, true works of art. These are engravings and sculptures representing in a very natural manner, but very true and well studied, representations of animals.

But with the Robenhausian invasion this first start in art completely disappeared. We see no more ornamentation, or only rudiments exist, as in certain dolmens of the Mœbihan. These consist simply of fantastic combinations of different lines representing no living object. In the region whence the Robenhausian migration proceeded, we see certain peoples, as in Persia, who in decoration, still in our time, make only combinations of lines.

The first monuments, dolmens and menhirs, were brought to us by the Robenhausian migration. We find these monuments at the north and south of the region whence has started this migration. We have discovered dolmens in Palestine, especially among the Moabites; we have found them still more to the north of Asia Minor. On the other hand, it is well known that dolmens are found in the Caucasus, and that they pass into the Crimea.

Finally, at what date has the migration which we have just studied, taken place? Certainly it is very rash to seek the date, even approximate, of events so distant. However, it seems to me well to divert our researches in this direction; so without according them much importance, I proceed, finally, to present some considerations in this respect. It seems to me that we can affirm that the Robenhausian migration was anterior to the great Egyptian civilization. Indeed, the men comprising this migration did not know, for a long time, indeed a very long time, anything more than the use of stone. The Egyptian civilization, from the first dynasty, was in possession of metals. We submit that there were no relations between the Egyptians and the countries whence the emigrants departed, but it was not long before this relation was to be established, since from the fifth and the sixth dynasty Egypt had borrowed much from Asia, notably that which relates to the working of metals. The populations which invaded Europe had, therefore, already quitted Asia at this epoch.

HISTORICAL SKETCH OF THE SCIENCE OF BOTANY IN NORTH AMERICA FROM 1635 TO 1840.

BY FREDERICK BRENDEL.

A HISTORY of the science of botany in North America means not in this sketch a history of that science in all its branches, but rather the history of traveling and local collectors, and of descriptive botany so far as it concerns American plants. For until Prof. A. Gray's popular book, "How Plants Grow" appeared in 1858, not a single work of any importance was published in this country, either on anatomy or on the physiology of plants, not even a single one of the many systems ever proposed had its origin in America. And yet the labors of American and foreign scientists in America contributed their large share to the advancement of science. They furnished the material for the work in all the other branches of botany, and particularly in the geography of plants. Most of them did a toilsome work, exposed in the wilderness to manifold fatigues and perils; many died far from home on the glorious battlefield of science, as it were, sword in hand; some a violent death, others swept away by a pernicious climate.

1635–1800.—It was in 1635 that the first book on North American plants ever written, was published by Jacques Philippe Cornut, a French physician. He described Canadian plants brought over to Europe, in a book entitled: *Canadensium Plantarum Historia.* It is illustrated by good drawings, most of the species being recognizable at first sight, though the names given are quite different from those now in use. But the work does not contain, as might be inferred from the title, Canadian plants only, but also some others from Spain and the Orient. Not until thirty-seven years afterward, in 1672, was another account of American plants given by John Josselyn, in a book entitled *Rariora Novæ Angliæ*, and in 1674, in an account of two voyages in New England.

At the same time, in 1672, Wm. Hughes published in London, The American Physician, or a Treatise of the Roots, Plants, etc.

In Ray's Historia Plantarum, 1688, second volume, we find a "Catalogus plantarum in Virginia observatarum," by John Banister, an English missionary and botanist, who came, in 1680, to Virginia, where he made his collections. The same catalogue

was republished, in 1707, in Petiver's Memoirs for the Curious. About the same time an Englishman, Wm. Vernon, and a German, David Krieg, collected, in Maryland, several hundred new species, which they sent to Ray, Petiver, Sir Hans Sloane and others.

James Petiver, a London apothecary, described, in 1706, in "Pterigraphia Americana," some North American ferns, and Leonard Pluckenet, a London physician who lived from 1642 to 1706, figured many North American plants in "Almagestum Botanicum," 1696, and "Almatheum Botanicum," 1705.

The same year came the English naturalist, John Clayton, (1685-1773), to Virginia, where he made his collections, afterwards described by Gronovius, a distinguished Dutch botanist at the University of Leyden, in Holland. His "Flora Virginica Exhibens Plantas, quas J. Clayton in Virginia collegit," was published in 1743, and a second edition by Gronovius, the son, 1762, augmented by observations of Clayton, Colden, Mitchell and Kalm.

From 1712 to 1719, Mark Catesby, another English naturalist, collected in Virginia. A second time he started from England and arrived, in 1722, in South Carolina. He traveled three years in that State, in Georgia and Florida, visited the Bahamas and came back to England in 1726, where he published from 1731 to 1743, the valuable work, "The Natural History of Carolina, Florida and the Bahama islands," two volumes in folio and a supplement with two hundred and twenty colored plates. The descriptions are in English and French; a German edition was published in 1750. After his death (1749) was published his Hortus Britano-Americanus, in which he described the trees and shrubs of the British colonies in North America adapted to the soil and climate of England. London, 1763.

Here may be mentioned a natural history of North Carolina, by Brickell, in Dublin, 1737.

The Swedish naturalist, Peter Kalm, explored the eastern part of Pennsylvania, New Jersey, New York and Canada during the years 1748 to 1751. He was sent by the Swedish government at the proposal of Linnæus, whose pupil he was. The original motive was the American mulberry (*Morus rubra*), which was known to grow as far north as Canada, in a climate similar to that of Sweden. It was intended to acclimatize the tree and to

introduce the culture of the silkworm in Sweden. The extensive botanical collections were worked up by Linnæus and embodied in his herbarium, where they exist yet.

Linnæus published, 1753, the first edition of his "Species Plantarum," in which he described 5938 species, all that was known at that time, and of which 5323 were phænogamous. In all his writings the number of species he was acquainted with was 8551 (7728 phænogamous and 825 cryptogamous). Amongst these are 1075 species either common to the eastern and western continents or only North American, inclusive of the Arctic regions and exclusive of Mexico.

Another contributor to the herbarium of Linnæus was Cadwallader Colden, Lt. Governor of New York, who was born in Scotland, 1688, and died in New York, 1776. The catalogue of his collection is published in "Acta Societatis Scientiarum Upsalensis, 1743–1744. His daughter, Miss Jenny Colden, wrote a Flora of New York, with drawings, the manuscript of which she transferred, before her death, to Wangenheim; afterwards it was incorporated into the Banksian Library, but never published.

Some Canadian plants were described by the French missionary, Xavier de Charlevoix, in his "Histoire et description générale de la nouvelle France, 1744." About the same time, John Bartram (born 1701, died 1777 in Philadelphia) traveled to Lake Ontario, and published his valuable observations in 1751. His son, Wm. Bartram (1739–1823), was the first to extend his botanical excursions to the Southern Alleghanies. He left Philadelphia in 1773, traveled through Florida and Georgia to the Cherokee country, and went through Alabama to Mobile in 1776. He published his voyage in Philadelphia, 1791. This valuable work was afterwards translated into the German, in 1794, and in French, in 1799.

John Mitchell, an American physician in Virginia, published additions to Linnæus' first edition of Genera Plantarum in his "Dissertatio de Principiis Botanicorum."

Reinhold Forster, naturalist to Cook's second expedition, compiled a catalogue of the plants of North America, in 1771, without descriptions.

A number of species, common to the Southern States and the West Indies, were made known by the important discoveries of Chas. Plumier (1690–1695), of Nic. Jos. de Jacquin (1754–1759)

and of Olaf Swartz (1785–1789). Only the latter spent a year on the North American continent before he went to the West Indies, where he alone discovered and described 850 new species. The first came from France, the second from Germany, the last from Sweden.

At that time Humphrey Marshall made the woody plants his special study. He published his "Arboretum Americanum," containing 276 species, in Philadelphia, 1785, which in 1788 was republished in Germany. The German foresters took a special interest in the matter, as many American woody plants had already found their way into the German nurseries, and by some experiments made it was known that for many purposes some sorts of American timber were superior to the indigenous, and as the greater demand for fuel in some industrial districts resulted in a final scarcity of wood, they thought that the cultivation of American timber in the German forests would be, by its more rapid growth, of great advantage.

Captain[1] Wangenheim, of the Hessian troops, afterwards Prussian forest-officer, studied, during his eight years service in America, the timber of this country with regard to its usefulness and practicability of culture. In 1781 he published descriptions of some North American trees, and after his return to Germany a larger work with drawings, 1787. There are many good observations on the soil and climate and their influence upon the culture of the different species, but the drawings are inferior, and in one there is a great error which is worthy of notice. On plate 18 is figured the leaf of *Carya olivæformis* and what is intended to represent its fruit, but looks rather like a pea nut. Probably he had never seen the nut, which he described as "kidney shaped," though he examined, in Wm. Prince's nursery at Flushing, on Long Island, the young tree not yet bearing. As he was eager to obtain the fruit, somebody by mistake, or perhaps for jest, may have given to him a pea nut for a pecan nut, which he drew. He gives a short history of the tree, which was unknown in the English colonies until the peace of 1762, when by chance some fur-traders brought a small number of the nuts to New York. Wm. Prince planted (1772) thirty nuts and raised ten plants, which (except two retained for propagation) he sold to England at ten guineas a piece.

[1] Here may be corrected an error in the preface of Torrey's Flora of New York. Wangenheim was not a surgeon nor an M. D.

In 1783, was sent over to America from Vienna, a scientific expedition under the charge of Prof. Marter, assisted by Dr. Stupicz, two gardeners and one designer. From Philadelphia they made excursions in Pennsylvania, to Virginia and Carolina. In the latter State, Marter met Dr. Schoepf, surgeon in the service of the Margrave of Ansbach, another German petit-tyrant who sold his poor subjects to the English. Both made together an excursion to Florida and the Bahamas. Marter brought large collections to Vienna, and Dr. Schoepf afterwards published a "Materia Medica Americana," Erlangen, 1787, and his "Travels Through the North American States," Erlangen, 1788.

An Italian nobleman, Luigi Castiglioni, traveled from 1785 to 1787 in the Eastern States, and published, 1790, his "Viaggio negli Stati Uniti del America Settentrionale," in two volumes. The latter half of the second volume contains observations on the useful plants. Like Wangenheim he gives to his countrymen some hints in regard to acclimatation. He describes most of the eastern and southern woody plants and gives a few good drawings (*Franklinia alatamaha* of Marshall, now *Gordonia pubescens*, *Quercus banisteri* and *Rhus venenata*). He made himself acquainted with the scientific men of the country, and in a passage (p. 163 second volume) where he objects to the assertion of Raynal (Histoire Philosophique et Politique), that America has never produced a single prominent man, be it in science, art or any other branch, he names, after mentioning a number of military, political and scientific men, the botanists, John Bartram and sons, Humphrey Marshall, Manasseh Cutler and Dr. James Greenway of Virginia, who made valuable collections.

Thomas Walter, the author of the Flora Caroliniana, published in London, 1787, was born, 1740, in Hampshire in England. He made his collections on a small area of scarcely more than twenty-five square miles on the Santee river, in South Carolina, but though he declares his collection very incomplete, it contains over a thousand species. He is a most modest man and not an over hasty species-maker. Whenever he is in doubt about a species he does not name it, but calls it "anonymous," for only few, he says in the preface, are allowed to name, and so he concedes to those who are the leaders in science, the right to name those plants now first described. To his name on the title he appends "agricola" (farmer), a learned farmer indeed, as the

whole book is written in Latin. In front of the book is a copper-plate (representing *Magnolia fraseri* Walt.) with the inscription: "To Thomas Walter, Esq., this plate of the new auriculated Magnolia is presented as a testimony of gratitude and esteem by his much obliged humble servant, John Fraser."

This man, John Fraser, was a Scotch botanist who collected from 1780 to 1784 in New Foundland, and from 1785 to 1796 in the United States. After a voyage in Russia he came again to America with his eldest son, John, in 1799. He visited the Alleghanies, where before, in 1789, he had traveled with Michaux, and on the summit of the Great Roan it was that he discovered the beautiful *Rhododendron catawbiense*, now cultivated in many varieties. After a visit on the island of Cuba, where he met Humboldt and Bonpland, father and son returned to England in 1802. Once more, 1807, both came to North America. The elder Fraser died, 1811, in Glasgow, but his son returned to America, where he continued his excursions up to 1817.

Palisot de Beauvais (1755–1820) came from St. Domingo to Philadelphia in 1791. He extended his excursions to the Cherokee country in the Southern Alleghanies. Of his collections, a large part was lost by shipwreck.

L. A. G. Bosc (1759–1828), a friend of Michaux, came from France to Charleston, in 1798, made some excursions in the vicinity of that city, traveled northward to Wilmington, N. C., and westward to the line of Tennessee. With a collection of 1600 species, chiefly grasses and cryptogamous plants, he returned in 1800, to France. Parts of his collection are found in the herbaria of Ventenat, Martius, Moretti and De Candolle.

Another Frenchman ought to be mentioned here not as a botanist, but because the matter he treated of is in near relation to botany. The Count Volney came to North America as an exile in 1795, and lived there till 1798. He had traveled previously in the Orient and had written the famous work, "The Ruins." In America he studied the soil and the climate. His "Tableau du climat et du sol des Etats Unis d'Amerique," was published in Paris, 1822. Though we cannot agree with all he said, particularly not with the statement that the ancient and annual fires of the Indians *caused* the prairies, the book contains much interesting matter. In the second chapter he describes, in general, the appearance of the country, particularly the extensive

woodlands, which he brings into three categories, as the southern, the middle and the northern, each characterized by its peculiar trees. Very interesting to Western men is his article on the colony at Vincennes, on the Wabash, and the early French life in Illinois.

The most important collections of this period were made by André Michaux, born in France, 1746. Before Michaux came to this country, he had traveled in Persia, 1782 to 1785. Then, in September, 1785, he embarked for New York, where he arrived in November of the same year. He established two gardens, one in New Jersey, the other near Charleston, S. C., for he was sent by the French government to collect living plants, to be transported to France. His excursions extended from Canada to Florida, and, in the west, to the Mississippi; farther than any collector before him had traveled. From Charleston he started for his first tour to the southern Alleghanies, in April, 1787, and returned the 1st of July; went to Philadelphia and New York, and returned to Charleston in August. Then, in February, 1788, he embarked for St. Augustine, Florida; returned to Charleston, and started again for the Alleghanies. During the following winter he was on the Bahama islands, and brought back to Charleston eight hundred and sixty young trees and shrubs. Then he made several excursions to the Alleghanies of North Carolina, through the valley of Virginia to Maryland and Pennsylvania. From New York he returned to South Carolina, via Baltimore, Richmond and Wilmington, and went again to the mountains. He returned to his nursery with twenty-five hundred young trees, besides many shrubs and other plants. In March, 1792, he sold his nursery near Charleston, and went to Philadelphia, collected in New Jersey and around New York; traveled via Albany and the Champlain lake, to Montreal and Quebec, and came back from there to Philadelphia in December.

In July, 1793, he undertook his great journey to the far west; he crossed the Alleghanies of Pennsylvania, descended the Ohio to Louisville; crossed Kentucky and Virginia, back to Philadelphia. In 1794 he visited again the Southern States; in May, 1795, he was in East Tennessee, crossed the Cumberland mountains, arrived, in July, at Louisville, traveled the Wabash up to Vincennes, crossed Illinois, descended the Mississippi in a little boat to the mouth of the Ohio, followed the Cumberland river up

to Clarksville, and arrived, via Louisville and North Carolina, at Charleston in August, 1796.

His travels in the Alleghanies are more particularly spoken of by Prof. Asa Gray, in his "Notes of a botanical excursion to the mountains of North Carolina." He had already sent to France more than sixty thousand living woody plants, and forty boxes with seeds, when he returned in 1796. Unfortunately, he suffered shipwreck off the coast of Holland, but he, and the collections which he brought, were saved, though the latter were damaged. He arrived at Paris in December, 1796, and published, in 1801, his great work on the American oaks, with excellent engravings. He then prepared the material for his Flora Boreali-Americana, but did not live to see it published.

Though he had desired to return to America, he accepted a proposition of Captain Baudin, to take part in an expedition to New Holland, and embarked on the 18th of October, 1801. Arrived in Isle de France, he left the expedition for Madagascar, where a malignant fever caused his death, on the 13th of November, 1802.

Jll.

Louis Claude Richard arranged the material of his Flora, and, in 1803, it was published by François André Michaux, the son. In this work are described 596 genera (555 vascular and 41 cellular) and 1740 species (1641 vascular and 99 cellular). Though many changes and reductions have been made in the course of time, 17 of the genera, proposed by him as new, are valid yet, and about 350 species.

Considering the vast area he traveled over, often without company, the poor facilities for traveling at that time, the troubles he had to undergo in transporting so many living trees and shrubs, the dangers he had to fear, risking his scalp at every step in the Western wilderness, we must admire that indefatigable traveler. His name stands as a prominent landmark at the dividing line of two periods, from which the labors of working botanists in this country took a new departure.

1800—1840.—Till then, at the close of the eighteenth century, as we have seen, most of the work was done by foreigners, partly engaged by European institutions or by private men. The few Americans did the work at their own expense, for there was no subvention by the Government at that time. Michaux, after his return from Canada, had, in 1792, entered into negotiation with

the Government about an expedition across the continent, but without any result. Indeed, the Union, with her four millions of inhabitants, was not a rich country at that time; she could not support scientific pursuits with the same liberality as she, in our times, does with her forty millions. And yet, ten years afterwards, an expedition was sent out under the command of Meriwether Lewis and Daniel Clark, the first that ever crossed the continent.

Before this expedition, only two botanists had visited the Pacific coast, Haenke and Menzies.

Thaddaeus Haenke (1761-1817), botanist with the Spanish expedition under Malaspina, collected about nine thousand species, of which a small part were from Northern California, in 1789. The herbarium is in the National Museum of Bohemia. Haenke did not return to Europe, but settled at Cochabamba, in Bolivia, where he died, 1817. Presl published the description of a part of his collections, under the title: Reliquiæ Haenkeanæ; 2 vols, with 72 plates. Here, by-the-by, may be corrected a geographical error, such as may often be found in learned writings. In Kunth's Enumeratio, vol III, page 361, under Juncus falcatus, we read: a Haenke lectus prope Monte Real (Canada). But Haenke was never in Canada, and it is meant Monterey, in California.

Archibald Menzies (1754-1842), a Scotchman, surgeon in the British marine, came first, 1786, to the North-west coast, and made there some collections. Afterwards, he took part in the famous expedition under the command of Vancouver (1791-95), and visited, several times, San Francisco, Monterey and Nutka Sound, on Vancouver Island. His collections are incorporated in the herbarium of the Edinburg Botanical Society, and, partly, in Hooker's herbarium.

This was all that was known of the botany of the northern Pacific coast, when the first American exploring expedition started from St. Louis, on the 14th of May, 1804. The party ascended the Missouri in keel-boats, cordeled by hand; wintered at Fort Mandan; crossed, in the next season, the Rocky mountains (at the Bitter-root mountains), and descended the Lewis fork and the Columbia river. The botanical collection from the Rocky mountains was, unfortunately, lost; only one hundred and fifty species, collected during the rapid return-march, were saved. These plants were described by Frederick Pursh.

The German botanist, Frederick Pursh, came to North America in 1799, a young man then, but not as young as he is made in Pritzel's Thesaurus, which, on account of so many errors in printing, is, in regard to dates, unreliable. According to Pritzel, he was born in 1794! What a young botanist, crossing the Atlantic, five years old! He was born in 1774.

"My first object after my arrival in America," he says in the preface to his Flora, "was to form an acquaintance with all those interested in the study of botany. Among these I had the pleasure to account one of the earliest, and, ever after, the most valuable, the Rev. Dr. Mühlenberg, of Lankaster, Pa., a gentleman whose industry and zeal for the science can only be surpassed by the accuracy and acuteness of his observations."

Heinrich Ludwig Mühlenberg, born 1756, was a Lutheran preacher in Lancaster, Pa., where he died, 1817. He published a catalogue of North American plants, 1813 (second edition 1818), and a "Description of North American Grasses," 1817.

Then Pursh visited Mr. Humphrey Marshall, already mentioned, the younger John Bartram and his brother William Bartram; Mr. John Lyon, who had the management of Mr. William Hamilton's gardens, and whose successor he was from 1802 to 1805, and Dr. Benjamin S. Barton, Professor of Botany in the University of Pennsylvania, who lived from 1766 to 1815, the author of "Collections for an Essay toward a Materia Medica of the United States," 1798 (second edition 1812-1814); of a "Flora Virginica," first part, 1812, but not continued, and of "Geographical view of trees and shrubs," 1809.

In 1805, Pursh set out for the Alleghanies of Virginia and Maryland; in 1806 he went to the Northern States, as far as New Hampshire; in 1807 he took charge of Professor Hosack's botanical garden of New York; in 1810 he visited the West Indian islands, and returning in 1811, landed in Maine, and embarked the same year in New York for England, where he published his Flora Americæ Septentrionalis, London, 1814, in 2 vols., with 24 engravings. This Flora contains about 740 genera and nearly 3000 species.

It will be easily understood that Pursh's Flora, which was published eleven years after Michaux's, must be richer in genera and species, when we consider that Michaux described only such species as he collected himself, and that Pursh received contribu-

tions from many parties. Except the small collection of Lewis and Clark, he used the herbaria of J. Lyon and Barton in Philadelphia, of Hosack in New York, of Le Conte in Georgia, of Peck in Massachusetts, and a number of species received from Alois Enslen, an Austrian gardener, who made large collections in the Southern States and Western territories, which are now in the Imperial Museum of Natural History in Vienna.

Then, in England, Pursh examined the herbaria of Clayton, Pallas, Plukenet, Catesby and Walter. In Bank's herbarium he found a number of the plants collected by Archibald Menzies on the North-west coast.

Pursh returned to America with the intention to explore Canada, where he died in 1820.

C. C. Robin,[1] a Frenchman, traveled, 1802-1806, in Louisiana and West Florida, which at that time included the southern parts of the States of Mississippi and Alabama. The incidents of his voyages he published in 1807, and in an appendix he described the plants, found on his tour, very vaguely, as he indeed was not a botanist. It is not known that he ever brought to France the specimens of those plants. From this written material was fabricated, by Rafinesque, a fancy work called Florula Ludoviciana, published in New York, 1817.

Constantin Samuel Rafinesque-Schmaltz is his full name. He was a Sicilian, and came to America in 1802, where he remained three years, and then again in 1815, and never returned, for he died in 1840, in this country. A. Gray published, in the American Journal of Science and Arts, a paper on his numerous botanical writings. Gray calls him an eccentric but certainly gifted man. It is true, some of his observations are really good, some of his genera and species are acknowledged now and will be in the future, but the greater part are trash; most of his numerous species can never be found, for they have no real existence in nature. He was a polygrapher—he wrote on everything; even poetry, the worst of all, he committed. At last he made a perfect fool of himself; he had such a mania for classification and registration, that he once proposed—twelve new species of thunder and lightning! His travels extended, in 1802-4, over the States of New Jersey, Pennsylvania, Maryland, Delaware and Virginia; in

[1] Not the godfather of the genus Robinia. That was Jean Robin, who lived from 1550 to 1629, in Paris.

1815 and 1816, mostly in New York, New Jersey and Pennsylvania; 1818 to the West (Ohio, Indiana, Kentucky and Illinois). To enumerate all his publications would be a waste of time and paper.

François André Michaux (1770-1855) had already traveled with his father. In 1801 he started again for America, to explore the Western States. In June, 1802, he crossed the Alleghanies of Pennsylvania, on foot, descended the Ohio in a boat from Wheeling to Limestone; crossed Kentucky in a south-westerly direction, and Tennessee as far as Nashville, and returned via Knoxville in East Tennessee, to Charleston, S. C., where he arrived on the 18th of October, 1802.

After his return to France in 1803, he published his "Voyage a l'Ouest des monts Alleghanys," Paris, 1804. The book contains many valuable observations on vegetation, wild as well as cultivated. 1805, he published a work on the naturalization of North American forest-trees, and 1810-1813, his great work, "Histoire des arbres forestières de l'Amerique septentrionale." There is an English translation, published in Philadelphia, 1859; The North American Sylva, three volumes, with 145 plates, uniform with Thomas Nuttall's work with the same title, published 1842-1854, which contains, in three volumes with 121 plates, those trees which are not described in Michaux's Sylva, mostly trees from the Rocky mountains, California and Florida, not known before.

Thomas Nuttall, a native of Yorkshire in England, and a printer by trade, came to America about the year 1808. He was, like Michaux, an indefatigable traveler. In company with John Bradbury, who had already explored the vicinity of St. Louis during the year 1810, he traveled, 1811, the Missouri upward to Fort Mandan; 1816, he was in the Alleghanies, in Kentucky and Ohio. On the 2d of October, 1818, he started from Philadelphia for Pittsburg, descended the Ohio to its mouth, then the Mississippi to the Arkansas river; this river upward to the Fort Smith; from there in a south-westerly direction to the Red river. After his return to Fort Smith, he followed the Arkansas farther up to the mouth of Verdegris river, and Grand river, and northward to the Osage saltworks. This latter excursion was full of hardships, disease, Indian pillaging and peril of life. Returning, he descended the Mississippi to New Orleans, where he arrived on the 18th of February, 1820.

From the manner of writing, we may often perceive the character of a man. Whoever may read his "Journal of travels into the Arkansas territory," published in Philadelphia, 1821, will be delighted at the plain, unpretending style, the "unvarnished tale," as he expresses himself in the preface, and will divine in Thomas Nuttall an amiable man.

In the years 1834 and 1835, Nuttall crossed the Rocky mountains to the Pacific coast, explored Oregon and California, made an excursion to the Sandwich islands, and returned around Cape Horn to the Atlantic coast. Besides the above-mentioned books, he published his "Genera of North American plants," in two volumes, Philadelphia, 1818; an "Introduction to systematic and physiological botany," Cambridge, 1827, and numerous descriptions of new plants, mostly in the Proceedings of the Academy of Natural Science, in Philadelphia. He died at the ripe age of seventy-three, on the 10th of September, 1859, in Lancashire in England.

Nuttall and Bradbury are mentioned by W. Irving in his Astoria, in which he describes the voyages of the parties sent out to Oregon by Mr. Astor. As both gentlemen left the expedition on the upper Missouri, these voyages had no further relation to botany.

Several other foreign botanists collected at that time in North America. Alire Raffenau Delile, professor of botany at the University of Montpellier, in France, after his return from the French Scientific Expedition in Egypt, a prominent member of which he was, came over to America and collected during three years, in the vicinity of Wilmington, N. C.

José Francisco Correa de Serra, secretary of the Royal Academy of Lisbon, came in the year 1813 to New York and Philadelphia, from where he made several excursions.

From 1817 to 1823 Mr. Milbert collected for the Museum of Natural History at Paris. He lived in New York and extended his excursions to the Ohio, Mississippi, Lake Superior and Canada.

Active American botanists of that time were Amos Eaton, professor in Albany, N. Y. He lived from 1776 to 1842, and published the first edition of his Manual of Botany, 1817, and of eight editions the last in 1841.

James Bigelow was professor of botany in Boston. His first edi-

tion of Florula Bostoniensis appeared in 1814, the third in 1840, and his American Medical Botany, 1817–1821, in three volumes with sixty colored plates.

William Baldwin, born in Pennsylvania 1779, collected in 1811, in Delaware, then in Georgia and Florida, and went, 1817, to Buenos Ayres, in South America. He died on the 31st of August, 1819, as a member of Major Long's first expedition, in Missouri. Darlington published, 1843, Reliquiæ Baldwinianæ. This expedition, by order of the Government, under the command of Major Long, started from Pittsburg in April, 1819, and proceeded the same year up the Missouri to Council Bluffs, where they wintered. Dr. Baldwin, the botanist of the expedition, sick already when the party set out from Pittsburg, died in Franklin, Mo., and Edwin James took his place, who compiled the account of the expedition in two volumes, 1823; the same year it was published in London in three volumes. The party started again on the 6th of June, 1820, from Council Bluffs, moved up the Platte river and examined the mountains from the South fork of the Platte to the Arkansas. Dr. James ascended the grand peak described by Major Pike in an account of his expedition in the years 1805–1807, which furnished no botanical matter. This peak is, in the narrative, called James' Peak; Fremont afterwards changed it to Pike's Peak, although Pike had only seen it and James was the first that ascended it. In returning, one part of the command followed the Arkansas river, the other the Canadian river. The catalogue of the collected plants, 500 to 600 species, was published by James, in 1825, in the Transactions of the American Philosophical Society, II, 172–190. James died 1861, near Burlington, in Iowa; he was born in Vermont, 1797.

In the period from 1820 to 1830 several Floræ of more or less limited parts of the United States were published. The best known are: Botany of South Carolina and Georgia, 1821-1824, in two volumes, with twelve plates, by Stephen Elliot, professor in Charleston, where he died 1830; the Flora of the Northern and Middle States, by John Torrey, 1824, and the Flora Cestrica (of Chester county, Pa.), 1826, by William Darlington, who lived from 1782 to 1863, and published the third edition of his Flora in 1853.

Lewis David v. Schweinitz, born in 1780 at Bethlehem, Pa., where he lived to 1834, published, in 1821, "Specimen Floræ

Americæ Septentrionalis Cryptogamicæ," containing the liverworts, and 1825, a Monograph of the genus Carex. He collected the fungi of Carolina, a catalogue of which, containing 1373 species, was published by Schwaegrichen, the well known cryptogamist, in Leipzig, 1822.

The catalogue of plants collected in the North-western territory during Major Long's second expedition, is written by Schweinitz. This expedition was described by Wm. H. Keating, the geologist of the party, and published in London in 1825, in two volumes, entitled, " Narrative of an Expedition to the Source of St. Peter's river, Lake Winnepeek, Lake of the Woods, etc., performed in the year 1823." The party left Philadelphia on the 30th of April, and the route of the expedition was the following: Wheeling, Fort Wayne, Chicago, Fort Crawford, Fort St. Anthony, up the St. Peter's river to its source, down the Red river to Lake Winnipeg, Rainy lake, Fort Williams on Lake Superior and return on the lakes. Edwin James was appointed botanist, but he missed the place of meeting, so Mr. Thomas Say, the zoölogist of the expedition, undertook to collect the plants. As several boxes containing collections, and dispatched during the expedition, were lost, the botanical collection was very poor, only 130 species. As poor as the collection was, the description of the species called new by Schweinitz, are mostly riddles not yet solved. So the expedition, otherwise interesting, was unimportant as to botany.

Dr. Douglass Houghton, who met, in 1845, a sad end by drowning in Lake Superior, was a member of Schoolcraft's Expedition to the sources of the Mississippi river in 1832, the narrative of which was published in 1855. He collected about 250 species of plants, only a few of which were new.

Up to this time a number of botanists were at work on the Pacific coast.

Adelbert Chamisso de Boncourt (1781–1838) and Frederik Eschscholtz (1793–1831) were commissioned by the Russian government, the one as naturalist, the other as physician, to the Russian Exploring Expedition in the Pacific and Behring straits, under the command of Kotzebue, 1815–1818, and explored Alaska and a part of the coast of California. The collections are partly in the royal herbarium at Berlin, partly in St. Petersburg.

The plants collected by Lay and Collie, of the expedition of

Capt. Beechey to the Pacific, 1825–1828, were described by Sir Wm. Jackson Hooker and G. A. Walker-Arnott, and published in London, 1841, a quarto volume with ninety-four plates. A part of these plants were collected in California.

Carl Heinrich Mertens, born in Bremen, 1796, took part in the Russian expedition under the command of Capt. Lütke, 1826–1829. Amongst his collections was a number of plants from the Island of Sitka, which, as Mertens not long after his return died in St. Petersburg, were described by Bongard in the memoirs of the Academy of Science of St. Petersburg, 1832. His account of the vegetation of Sitka was already published, 1827, in Berlin, by A. Chamisso, with observations of the same.

A member of the same expedition was F. H. v. Kittlitz, who published twenty-four fine landscape views of the Pacific islands and coasts, amongst which are four that give a good idea of the vegetative character of Alaska. Three of them are rather roughly copied in the U. S. Agricultural Report for 1868.

David Douglas, born in Scotland, 1790, traveled for the Horticultural Society of London. He arrived in July, 1823, in New York, made excursions through New York State to Canada, and returned to London 1824. The society was so well pleased with his collection that he was sent the same year to Oregon, where he arrived in February, 1825, on the same ship with Dr. John Scouler, another Scotchman, who was afterwards professor in Dublin, and died, seventy-two years old, in 1871, in Glasgow, his birthplace. Douglas took up his residence in Fort Vancouver, and made from there excursions into the interior of Oregon Territory, and to Northern California, then he crossed the Rocky mountains to the Athabasca river, and to York Factory on the shore of Hudson's bay. In October, 1827, he returned to England. In 1830 he undertook his second voyage to Oregon and Upper California, and in 1833 he crossed the Pacific to the Sandwich islands, where he lost his life in a horrible manner. It was on the 12th of July, 1834, that on an excursion he fell into a deep excavation made for the purpose of capturing wild beasts; a wild ox, plunging soon after him into the same hole, killed him. This was a time of disaster for traveling botanists. A year before Douglas, in February, 1833, Thomas Drummond died in Havana; two months only after Douglas, was Carl Beyrich taken away by the cholera at Fort Gibson, the next year Joseph Frank died in New

Orleans, and in 1837 H. B. Croom lost his life by shipwreck on the coast of North Carolina.

H. B. Croom was born in North Carolina, 1799; his catalogue of plants of Newbern, N. C., was, after his death, published by Torrey.

Joseph Frank came to America, 1835, and collected for a botanical society in Germany (the Unio Itineraria). He traveled in Pennsylvania, Ohio, Missouri and Louisiana.

Carl Beyrich, another German, was sent by the Prussian government. He collected, 1833, in North and South Carolina and Georgia 1300 species in one season. The next year he went with a military expedition (probably that of Col. Dodge) from St Louis to the Indian Territory, to leave it no more.

Thomas Drummond, brother of the well known Australian traveler, James Drummond, took part in Franklin's second expedition as an assistant of Dr. Richardson, in 1825. At Cumberland House he left the party to explore the Rocky mountains of the British Territory. In 1831 he collected in the Alleghanies, and then in the vicinity of St. Louis and New Orleans, where he embarked for Texas. He explored the country around Austin, Brazoria and Galveston, went to Apalachicola, in Florida, and started from there in February, 1833, for Havana, where he died in the month of March.

Already before Drummond, in 1827–1830 Texas was, in its more western parts, explored by Jean Louis Berlandier, from Geneva. He also, though later in 1851, died far from home in Matamoras, on the Rio Grande.

Maximilian, prince of Wied, traveled in the Western Territories in the years 1832–1834, and brought back to Germany a small collection of about two hundred species, which were published by Nees v. Esenbeck, professor of botany in Breslau. There was nothing new except the genus Sarcobatus, proposed by Nees and afterwards described again by Torrey under the name of Fremontia.

Many American botanists were at work in this period, collecting the plants about their homes or exploring the vegetation of larger districts. The most prominent ought to be named here: In Massachusetts, Bigelow, Tuckerman, Oakes, Dewey; in Connecticut, Barratt; in New York, Sartwell, Carey, Beck, Bailey; Pennsylvania, Pickering, Durand and Darlington; in North

Carolina, M. O. Curtis; in Georgia, Boykin and Le Conte; in Florida, Chapman, Leavenworth and Blodgett; in Alabama, Gates; in Louisiana, Hale, Carpenter and Riddell, who, in 1835, published a Flora of the Western States, and afterward a Flora Ludoviciana. Other catalogues of local floras were compiled of the plants in the vicinity of Charleston, S. C., by Bachman, 1834; of the plants of Columbia, S. C., by Gibbes, 1835; of the plants near Baltimore, by Aikin, 1836. Dr. Pitcher collected in Arkansas, afterwards in Michigan; in Kentucky Dr. Peter and Prof. Short; in Illinois the same and Buckley; in Ohio, Lea and Sullivant; in Michigan, Wright; in Wisconsin, Lapham; in Missouri, Engelmann.

In the botany of the Californian survey, the first of which volume is now published, we find often the quotation of Plantæ Hartwegianæ.

Theodor Hartweg, a German gardener, was sent by the English horticultural society to Mexico and California, where he collected during the years 1838-1839. Many of the plants described and published by G. Bentham, under the above-mentioned title, in 1839-1848, occur in what was formerly the northern Mexican countries.

J. N. Nicollet, a Frenchman, employed under the Bureau of Topographical Engineers (since 1838), explored the basin of the upper Mississippi during the years 1836-1840. To his party was attached the German botanist, Carl Geyer, the large collections of whom were sent to Drs. Torrey and Gray. These two bright stars had already risen above the horizon of the botanical firmament, and commenced, at the close of the fourth decennium, their great work, the Flora of North America, opening a new epoch in the history of American botany.

The interest in the science of botany was now wide awake amongst the American public, and the Government bore its rich share of it, spending large sums for scientific purposes, by attaching scientific men to the nearly unbroken series of expeditions and surveys which were now undertaken.

ON THE EXTINCT AMERICAN RHINOCEROSES AND THEIR ALLIES.[1]

BY E. D. COPE.

[illegible] species of mammals which may be called rhinoceroses have been defined from materials obtained from the Tertiary formations of North America; and five additional species have been distinguished, which may be regarded as more or less nearly allied to that family. A few additional names have been proposed for supposed species whose characters are not yet established. In the corresponding formations of Europe and Asia, the fossil remains indicate a still larger number of species. The forms included in the family, first appear in both continents in the Lowest Miocene or Oligocene epochs; that is, in North America in the White River formation. The family still exists in Asia and Africa, but in Europe it disappeared during the glacial epoch. In North America it became extinct at a still earlier period, no remains of rhinoceroses having been found in beds of later age than the Loup Fork, or Upper Miocene period.

The genus *Hyracodon* (Leidy) which has a full series of incisor teeth, was formerly included in this family, and it agrees with the various genera in the structure of the molar teeth of both jaws. But I have ascertained that it differs so widely from them in some other respects, that it became necessary to regard it as the type of another family, the *Hyracodontidæ*. The mastoid bone forms part of the external wall of the skull as in tapirs, and the neck is quite elongate. It fact the *Hyracodon arcidens* must have had the proportions of some of the horses in this respect. There is also no posterior tuberosity of the mandibular condyle, so conspicuous in the rhinoceroses.

The following table explains the relations of the two families:

IV. Anterior exterior crescent of superior molars much reduced; inferior molars with cross-crests; superior molars and premolars alike, with cross-crests.

α. Mastoid bone forming part of the external wall of the skull; no postcotyloid tuberosity of the mandible; neck elongate .... *Hyracodontidæ*

γ. Mastoid bone excluded from the walls of the skull by the contact of the occipital and squamosal; a postcotyloid tuberosity of the mandible; neck short ....*Rhinoceridæ*.

The genera of *Rhinoceridæ* differ from each other as follows:

[illegible] or digits.

canine ?; no horn; posttympanic bone distinct.....*Aceratherium*.

[1] [illegible] paper published in the Bulletin of the U. S. Geol. Surv. Terr.,

II. ? Digits.

Incisors $\frac{1}{1}$; canine $\frac{0}{1}$; posttympanic bone distinct; an osseous tuberosity on each side the muzzle.. *Diceratherium.*

III. Three anterior digits.

Incisors $\frac{2-1}{1}$; canines $\frac{0}{1}$; no horn; posttympanic bone distinct...... *Aphelops.*

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a dermal horn; posttympanic distinct... *Ceratorhinus.*

Incisors $\frac{2}{2}$; canines $\frac{0}{1}$; a dermal horn; posttympanic ?.............. *Zalabis.*

Incisors $\frac{1}{1}$; canines $\frac{0}{1}$; a dermal horn; posttympanic process coössified with postglenoid process; no nareal septum...................... *Rhinocerus.*

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; a dermal horn; posttympanic process not united with postglenoid; no nareal osseous septum....................... *Atelodus.*

Incisors $\frac{0}{0}$; canines $\frac{0}{0}$; a dermal horn; posttympanic coössified with postglenoid; an osseous septum dartum......................... *Cælodonta.*

My catalogue of species of the above genera contains twenty-eight names, of which six belong to living species. The latter are *Ceratorhinus sumatranus* Cuv.; *C. lasiotis* Scl.; *Rhinocerus unicornis* L.; and *R. sondaicus* Cuv., all from Asia and Malaysia; and *Atelodus bicornis* L. and *A. simus* Burch., of Africa. It is possible that a species of *Aphelops* still exists in some of the Indian islands, in the *Rhinocerus inermis* Less. There are probably several distinct fossil species not in the list; but their characters have not yet been sufficiently made known to enable me to refer them to their proper places. It will be observed that eight species have been found in North American formations, ten in European, and three in those of Hindostan. It appears also that no extinct species of the true genus of *Rhinocerus* has yet been found in North America or Europe, and that no extinct rhinoceros of North America which is known, possessed a median dermal horn.

It can readily be seen that the genera above defined form a graduated series, the steps of which are measured principally by successive modifications of four different parts of the skeleton. These are, first, the reduction of the number of the toes of the anterior foot; second, the reduction in the number and development of the canine and incisor teeth; third, the degree of closure of the meatus auditorius externus below; and fourth, in the development of the dermal horns of the nose and its supports. While these characters have the tangible and measurable quantities which render them available for generic diagnosis, there are others which possess a similar significance, and which I now notice, so far as they are observable in the extinct species of North America.

I premise by observing that the *Aceratheria* and *Diceratheria* of this continent have only been found in the eastern and western divisions of the White River formation, while the species of *Aphelops* are confined, so far as is known, to the Upper Miocene or Loup River formation.

The posttympanic process is, it is well known, well separated from the postglenoid process in the tapir, so as to leave the auditory meatus widely open below. The arrangement is similar in *Hyracodon*. In *Rhinocerus*, as shown by Flower, the meatus is closed below by the coössification of the two processes. In the oldest genus of the family *Aceratherium*, the relations of the parts are as in *Hyracodon*. In *Aphelops* the two processes approach each other, but do not come in close contact as in the genus *Ceratorhinus*.

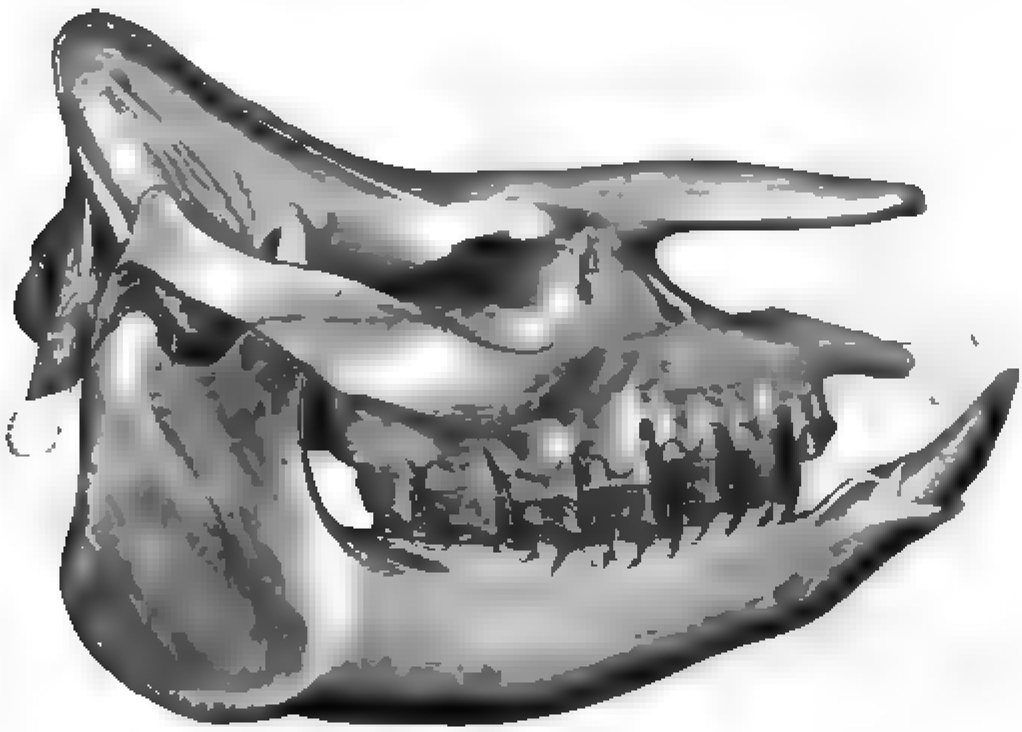


FIG. 1.—*Aphelops megalodus* Cope, one-sixth natural size. Loup Fork beds, Colorado.

The postglenoid process is low and transverse in the tapirs; in *Rhinocerus* it is long and has a triangular section. In some species of American *Aceratheria* its form is much like that of the tapirs (*A. mite*, *A. occidentale*); while in *Diceratherium pacificum* and in the species of *Aphelops*, the form of this process is as in *Rhinocerus*.

In the tapirs, the foramina sphenoörbitale and rotundum are distinct. They are also distinct in *Aceratherium mite*. In *D. pacificum* they are confluent, but the walls of their orifice present two opposite projections, which are the rudiments of a dividing septum. In *Aphelops* these foramina are one as in *Rhinocerus*. At the same time, the external wall of the alisphenoid canal is shorter and thinner in the *Aceratheria* than in the *Aphelopes*.

In the older types of *Perissodactyla*, e. g., *Symborodon*, the foramen ovale is situated well in advance of the foramen lacerum from it by a considerable space of the structure is seen in *Hyracodon* and in

Aceratherium. In *Aphelops*, the foramen ovale approaches near to the f. lacerum, so as to be separated by a narrow bridge only in *A. megalodus*, which is wanting on one side in a specimen of *A. malacorhinus.* In the genus *Rhinocerus*, these foramina are not divided.

In the structure of the teeth, the same serial order is to be observed. Commencing with the incisors $\frac{3}{3}$ in the tapiroid types and *Hyracodon*, and canine $\frac{1}{1}$, we find $\frac{3}{3}$ $\frac{0}{1}$ in *Zalabis;* $\frac{1}{1}$ $\frac{0}{1}$ in *Aceratherium;* $\frac{2-1}{1}$ $\frac{0}{1}$ in *Aphelops;* $\frac{1}{1}$ $\frac{0}{1}$ in *Ceratorhinus* and *Rhinocerus*, to $\frac{0}{0-1}$ $\frac{0}{0}$ in *Atelodus* and *Cœlodonta.* As to the molars, in those of the upper jaw the series of modifications consists of successive complication of the transverse crests. In *Hyracodon*, as in the tapiroid genera, the external wall of the posterior molar is

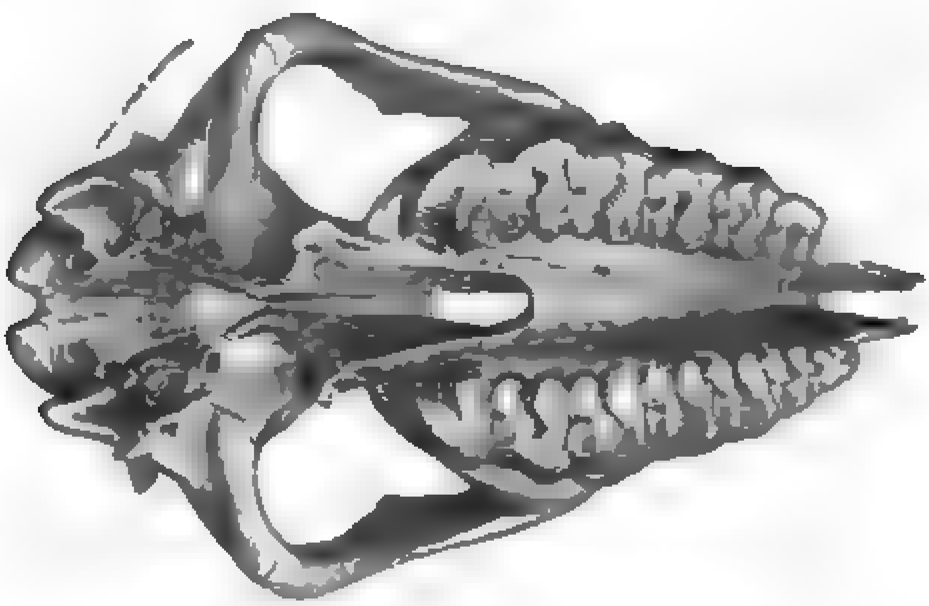


FIG. 2.—*Aphelops megalodus* Cope, inferior view of cranium represented in Fig. 1.

continued beyond the posterior cross-crest; in the *Rhinocerudæ*, generally the external wall is not continued beyond this crest, but is in line with the posterior cross-crest. In a specimen of *Aceratherium occidentale*, the posterior superior molar of one side is like that of *Hyracodon*, while that of the other side is like that of *Rhinocerus.* The cross-crests in *Aceratherium* are quite simple, having slight bulges into the median valley. In the species of *Aphelops* these bulges are more prominent, especially that of the posterior crest, which is more externally situated than that of the anterior cross-crest, so that the fundus of the valley is turned abruptly backwards. In several of the existing species, this bulge becomes an antero-posterior crest, and the fundus is further divided by other crests from the outer wall and elsewhere. The cingula become so elevated as to cause an isolation of the valleys as fossæ at a comparatively early stage of wear. This

state of things commences in the extinct species of Kansas, the *Aphelops fossiger.*

FIG. 3.—*Aphelops fossiger* Cope, skull from below, one-sixth natural size. Loup Fork beds of Kansas.

In the bones of the skeleton, modifications accompanying those of the cranium and dentition may be observed. The femur of the species of the earlier formations may be readily distinguished from that of those of the later Tertiaries by the forms of both the extremities. In the *Aceratheria* this bone resembles that of the tapirs in the form of the great trochanter. This process is produced at its external border, has a recurved apex, and encloses a deep trochanteric fossa. In *Aphelops* it is precisely as in *Rhinocerus*, obliquely truncate externally, without prominent apex or well marked fossa. In the *Aceratheria* the inner crest of the rotular groove is but moderately prominent; in *Aphelops* and *Rhinocerus* it is greatly developed.

The succession of development of the line of the *Rhinocerida* is now not difficult to trace, and I give the following diagram in explanation of it.

Cœlodonta
/
Rhinocerus. *Atelodus.*
\ /
Ceratorhinus.
|
Aphelops.
|
Zalabis. *Aceratherium.* *Diceratherium.*
\ | /

It is evident that the descent diverged at a comparatively late period of geological time into two lines, which are represented at the present day by the African and Indian species respectively.

The earliest species of the toothless or African series is the *Atelodus pachygnathus* of Wagner, whose characters have been so well worked out by Gaudry in his great work on the Fossil Fauna of Attica. That species sometimes presents a single small incisor or canine tooth in the mandible.[1] From what has preceded it is also apparent that the generally most specialized type of rhinoceros, the genus *Cœlodonta*, has become entirely extinct. Its three species yet known, were confined to Europe and Northern Asia, and the most formidable of them extended its range with the hairy mammoth within the Arctic circle. The *Cœlodonta antiquitatis* (the wooly rhinoceros) was evidently the most effectively armed of the family, as it had two horns, which, judging from the character of the surface of the skull to which they were attached, must have been of unusual size. To provide further against the shocks incident to their use in combat, the nareal septum was ossified, thus becoming a solid support to the nasal bones, etc., on which they stood.

It remains to look backwards, and to discover, if possible, the probable origin of the family in that of its earliest known genus, *Aceratherium*. A late survivor of this ancestral type is seen in the genus *Zalabis* Cope, of which one species, the *Z. sivalensis*, has been discovered by Cautley and Falconer in the late Tertiary of Hindostan. In this form, according to Falconer, there are $\frac{3}{3}$ incisors and $\frac{0}{1}$ canines. The early type, which corresponds most nearly with this genus, and which preceded the *Aceratheria* in time, is the genus *Amynodon* Marsh, which has left a species in the Uinta or Upper Eocene of Utah. Here the incisors are $\frac{2}{2}$ and the canines $\frac{1}{1}$. This formula is intermediate between that of *Aceratherium* and that of the Eocene tapirs, where the normal numbers $\frac{3}{3}$ $\frac{1}{1}$ prevail. According to Marsh, *Amynodon* further differs in the primitive condition of the premolars above, which, as in the *Lophiodontidæ*, differ from the molars in their greater simplicity. Thus it is probable that tapiroid animals, probably *Lophiodontidæ*, gave origin to the *Rhinoceridæ*, as Marsh has suggested. And it is further altogether probable that the general type of dentition presented by the *Rhinoceridæ*, *Lophiodontidæ*, etc., which I have named the palæotheriodont, took its origin from the type which is intermediate between it and the bunodont, viz: the symborodont, as I have pointed out in an essay on this subject.[2]

[1] The large tooth of the mandible described by the older authors as an incisor, has been regarded as a canine by Gervais. Subsequently Marsh adopted the same view.

[2] The Homologies and Origin of the Molar Teeth of Mammalia, etc. Jour. Academy Nat. Sciences, Philada., 1874, pp. 13–14.

The first appearance of dermal horns was apparently in a pair placed transversely on the nasal bones, in species of Eocene *Lophiodontidæ*, of the genus *Colonoceras.* The same character has been observed by Duvernoy in species of the Lower Miocene, which belong to the true *Rhinoceridæ*, and which Marsh has called *Diceratherium.* This genus appears to have terminated the line exhibiting this structure, and the family in North America remained without horn. As we have seen, the types possessing the median horn arose in Europe, in the *Ceratorhinus schleiermacheri* of the Middle Miocene, and still survives.

It may be observed in conclusion, that a successive increase of size in the species of this line has taken place in North America with the advance of geologic time. Thus, their probable ancestors of the genus *Hyrachyus* were the least of all. The *Acera-*

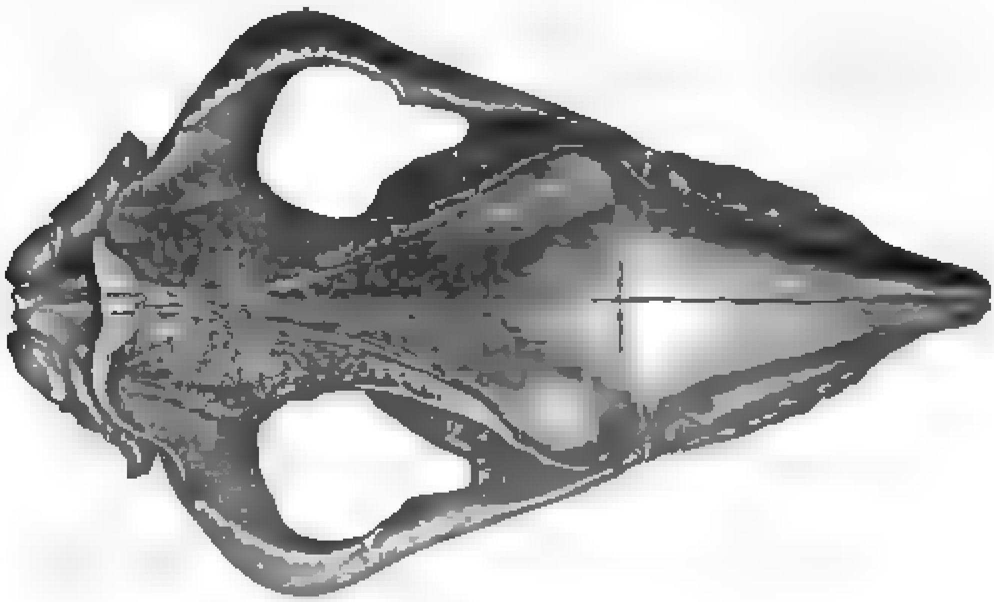


FIG. 4.—*Aphelops megalodus* Cope, skull from above (same as FIG. 1), one-sixth natural size.

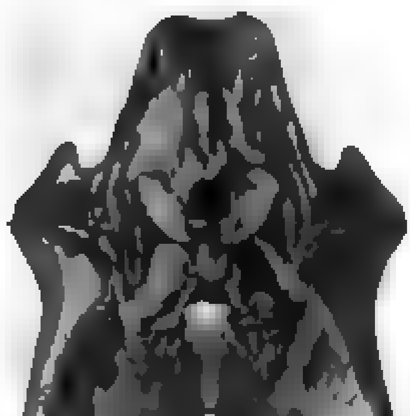
theria of the White River formation were larger, the oldest, *A. mite*, being the smallest. The *Diceratheria* of Oregon were larger still. The species of the Loup River or Upper Miocene formation were larger, and nearly equal to the large existing species.

Aceratherium Kaup. is characteristic of the Miocene or Middle Tertiary formations of Europe, and is the primitive form of the true rhinoceroses. Its four anterior digits relate it to the lower or more generalized perissodactylous types of the same and of older geological horizons, which are equally allied to the tapirs. The dentition differs from that of the genus *Rhinocerus* in the presence of two superior incisors, but agrees with it in the existence of one incisor and one canine on each side below, and in the forms of the premolar teeth. The species display great simplicity in the character of the crests of the molars. They also possess

the tapiroid feature of the non-closure of the auditory meatus below by the posttympanic process; and the postglenoid process is generally more like that of the tapirs than are those of the later genera *Aphelops* and *Rhinocerus*. The form of the femur is also quite characteristic, presenting tapiroid characters again in the shape of the great trochanter. This process is not flat and obliquely truncated as in the genera above named, but is horizontal proximally, and with a produced recurved apex and posterior crest, which bound a large fossa. The species are the smallest of the family, the *A. mite* having the dimensions of the Malayan tapir.

In the species of *Diceratherium* (Marsh) the cranium and limb bones present the characters above ascribed to the *Aceratheria*. In size they are intermediate between the latter and the *Aphelopes*. The two American species are known from the beds of the Truckee epoch of Oregon; a third species, *D. pleurocerus* (Duv.) has been found in France.

Aphelops (Cope) occupies a position intermediate between *Aceratherium* Kaup and *Rhinocerus* Linn. It agrees with the former in the presence of incisor and canine teeth, and in the absence of indication of a nasal horn, but differs from it in lacking the fifth digit of the anterior foot. In the last respect it is identical with the genus *Rhinocerus*, differing from it in characters already mentioned, in which it agrees with *Aceratherium*. From *Atelodus* Pom. it differs still more widely, as that genus wants incisor and canine teeth.



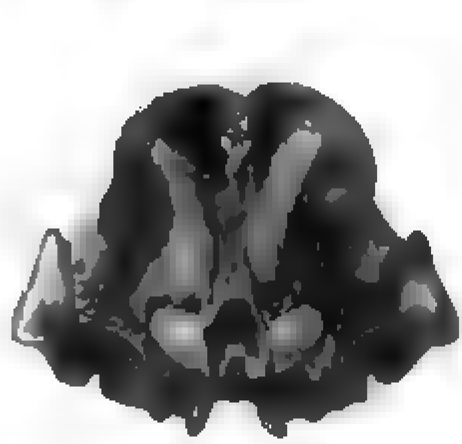


Fig. 5.—*A. megalodus* figured above, posterior view of skull.
Fig. 6.—*A. fossiger*, skull figured in Fig. 3, one-sixth natural size.

The evidence on which this genus rests is furnished by two species, the *Aphelops megalodus*, and the *A. fossiger*. In both of these animals, the number of anterior digits is known to be only three and in the former the inferior canines and alveoli for incisors can be seen in the specimens. In two other species provisionally referred to the same genus, the *A. crassus* and *A. malacorhinus*, the digits and incisor teeth are unknown but the last named species was certainly hornless, and it is supposed that the first named was

so also. Of the many mandibular symphyses from the Loup Fork formation which I have seen, none lack the canines and incisor teeth, so that it is probable that this character belonged to the two species above mentioned. A fifth species, the *A. meridianus* Leidy, I have provisionally referred here, on account of the similar character of the mandibular dentition; but its nasal bones and feet are unknown. Still another species, the *A. jemezanus* Cope, has been referred here, but on no other ground than that it is found in the same formation as the others.

Specific characters.—The species above named all present well-marked cranial or dental characters, or both. But it is important to take into consideration the general structure of the skeleton. I am in position to do this with three of the species named, the

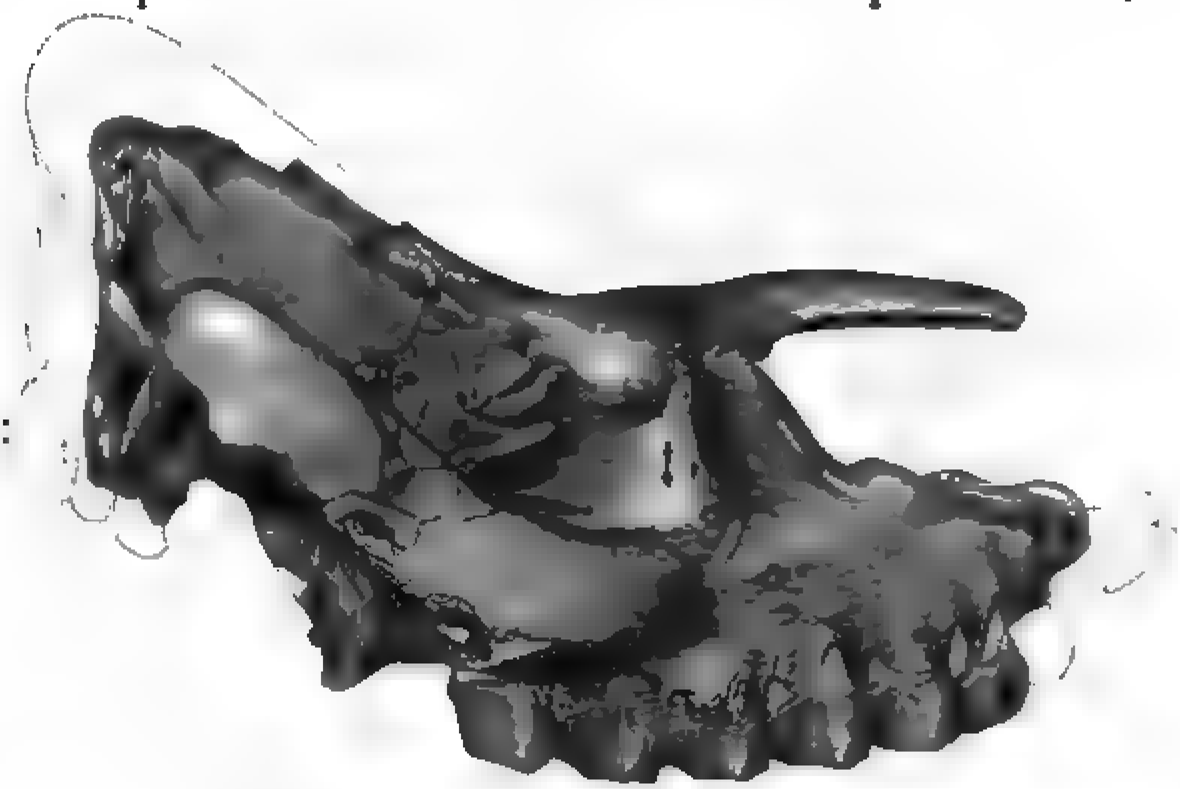


FIG. 7.—*Aphelops malacorhinus* Cope, skull one-sixth natural size, restored behind from another cranium.

A. megalodus, the *A. fossiger* (of this paper), and the *A. malacorhinus* and find distinctive characters present in nearly all their bones which I have observed. The *A. malacorhinus* is a comparatively long-limbed animal, and its apparent elevation was increased by the shortness of the body, and especially of the neck. There was probably a great development of the upper lip, or snout, and the face was concave in profile. The *A. megalodus* was somewhat intermediate in proportions between this species and the *A. fossiger* Its limbs were shorter than in the *A. malacorhinus*, and neck ... wer. The feet were more slender. The *A. fossiger* ... , and the length of the neck was about as in ... its form it must have been like a *Hippo*- ... d especially the feet, were very robust.

Position.—The longest known species, the *A. crassus*, was found by Dr. Hayden on the Niobrara River, Nebraska. Teeth presenting the same characters have been found in Northern Kansas and Eastern Colorado. The other species are more restricted geographically. A considerable exploration in the Loup Fork beds of North-eastern Colorado, conducted by myself in 1873, yielded four individuals of *A. megalodus*, but no fragments referable to the other species. Explorations in Northern Kansas by Russell S. Hill, of Philadelphia, produced five individuals of *A. fossiger* and five of *A. malacorhinus*, but not a fragment of *A. megalodus.*

History.—In my original definition of this genus, I relied on

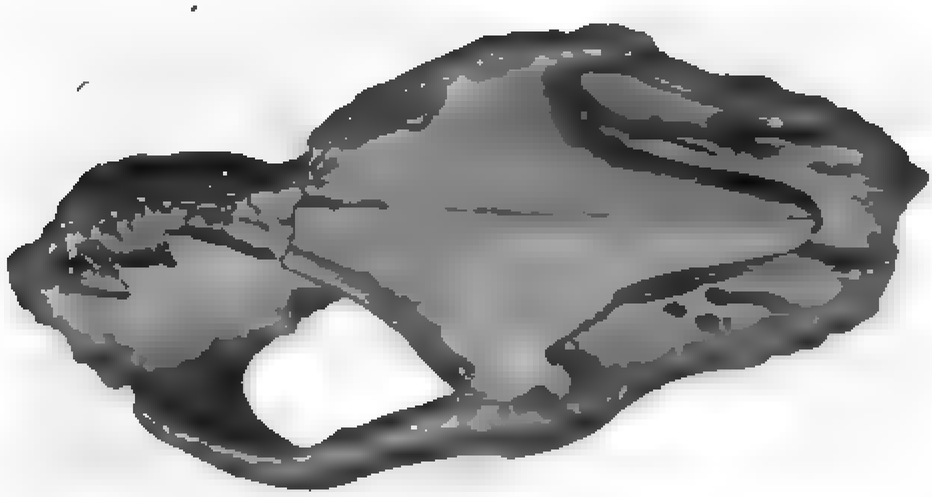


FIG. 8.—*A. malacorhinus* skull, represented in Fig 7 from above, one-sixth natural size.

the number of premolars in distinguishing it from *Rhinocerus*, as well as on the absence of the horn. These teeth are generally $\frac{3}{3}$ in *Aphelops*, and are said to be $\frac{4}{4}$ in *Rhinocerus*, in most works on the subject. These numbers are not constant; on one side of both jaws in *Aphelops* from Colorado, I have observed a first premolar, and on one side of the upper jaw of *A. malacorhinus* there are four premolars; the other side is injured. In several species of *Rhinocerus*, three premolars only are usually found in the mandible. I may add that Lesson and Peters[1] have described a *Rhinocerus inermis* Less., which is found living on some of the islands at the mouth of the Ganges. The only known specimens are the skulls, with portions of the skin, of a female and young. These are hornless, and in general structure allied to the *R. sondaicus*, yet presenting some important differences.[2] Should the characters of this form prove to be specific, and the male be found to lack the horn, it must be regarded as a species of *Aphelops*.

[1] Monatsberichte Berlin. Akademie, 1877, p. 68, pl 1–2

[2] Peters represents the posttympanic as not coössified below the meatus as in *R. sondaicus.*

RECENT LITERATURE.

... GENERAL ZOÖLOGY.[1]—The third part of this ... during the past summer, and though the ... for the present year, we will not wait for ... calling the attention of our readers to what ... valuable work of reference. It is planned ... from other zoölogical manuals, being writ... comparative anatomy. The first part ... the first being introductory, the ... nature of animal bodies in general, this ... of individuality and pleomorphism; ... treats of the subdivisions of the animal ... discussion of the doctrine of species. The ... 1877, and treats of the organization and ... the entire part being devoted to the organs ... and of circulation. The third part ... chiefly from an anatomical point of view, ... printed pages an account of the different ... the various groups of animals. Prof. ... done his work carefully. The wood... but often rather too small and indistinct. ... enough for anatomical drawings, still ... original, involving a large amount of work on ...

... CATALOGUE OF SERIALS.[2]—This most useful ... of the efforts of the author to bring about ... operation between the different libraries in and ... which valuable and costly works should not be ... that each library should aim to complete their ... separate departments. As the first step in ... reform was the preparation of a bibliographical ... serials, whether those now in course of publi... the labor was entrusted to Mr. Scudder, who has ... aptness and zeal to such work, together with an ... care in treatment characteristic of all his writings. ... the volume will be in constant use by the naturalist, ... literature of biology and the natural sciences gen... assumed enormous proportions.

... catalogue comprises a list of the serial publications of ... the towns or places of publication being arranged

[1] ... der Grundzüge des thierischen Bau und Lebens. Von H. ... Theil 1–3. Berlin, Verlag von Wiegandt, Hempel ... 1875–1879. 8vo, with 435 woodcuts.

[2] ... University. Special Publications. I. Catalogue of Scien... including the Transactions of Learned Societies in the ... tical Sciences. 1633–1876. By SAMUEL H. SCUD... Harvard College. 1879. 8vo, pp. 358.

alphabetically under each country. The index is subdivided into an index of towns, of titles and of minor subjects, such as anatomy, anthropology, botany, entomology, geology, &c., &c. A considerable amount of bibliographical information is given under the different titles, of much importance in treating of synonomy. The work will hereafter stand on the shelves of the naturalist's library side by side with Agassiz's Bibliographia Zoölogiæ, Engelmann's Bibliotheca Historico-Naturalis, Carus and Engelmann's Bibliotheca Zoölogica, Hagen's Bibliotheca Entomologica, supplementing these valuable works. It is gratifying to notice the appearance of such works as this and Coues' Bibliography of Ornithology in this country, as evincing the richness of American libraries in scientific works, and the number of those who use them with discernment.

We have no criticisms to make on the volume, as the arrangement seems to be all that could be desired. Doubtless, errors will be found upon using it, and the compiler invites criticism and the communication of errors, that they may be corrected hereafter. This is the first instance, so far as we now recollect, of the issue of such important and generally useful works by any library, and due credit should be given to the university whose librarian had the public spirit and enterprise to undertake the publication of such an expensive work without a special fund for such purposes.

ZITTEL'S HANDBOOK OF PALÆONTOLOGY.[1]—This will, when completed, be without doubt a most useful compendium of the subject, though to be authoritative a work on palæontology should, we think, be written by one who has been more active as a zoölogist than the talented author. The first part begins with a general history of the rise of palæontology and a statement of the subject in general, and the second *lieferung* carries us as far as the Echinodermata, *i. e.*, through the Cœlenterata, the latter including the sponges.

We notice that in the first *lieferung*, which was published in 1876, Bathybius is admitted to be an organism, as is the Eozoön.

In the second volume, of which the first *lieferung* has appeared, Prof Schimper treats of the fossil plants, beginning with the Diatoms and nearly completing the account of the ferns. Both authors treat their respective kingdoms alike, *i. e.*, in an almost purely systematic way, diagnoses of the classes, orders and genera being given, often with descriptions of the species.

The illustrations are numerous and usually excellent, but often on too small a scale, a fault of Pagenstecker's work, and of many German books, the woodcuts of Gegenbaur's Elements of

[1] *Handbuch der Palæontologie.* Unter mitwirkung von. W. PH. SCHIMPER. Herausgegeben von Karl A. Zittel. Band I. Lief. 1, 2. Band II. Lief. 1. München, 1876–79. 8vo.

Comparative Anatomy being a notable exception. This palæontology will consist of two volumes, and will, when completed, be a valuable work of reference, though almost entirely based on European forms.

MISS BALLARD'S INSECT LIVES.[1]—This attractive little book deserves commendation from the fact that the authoress has evidently the zeal of a genuine naturalist, has studied insects in the field and closet, and describes what she has seen in a clear and admirable manner. The first and best lesson in the study of insects is the rearing of a butterfly from the egg; one learns more of entomology in this than by any other method. This book will, we feel sure, induce boys and, we hope girls to gather caterpillars and rear butterflies just for the fun of the thing, while unconsciously they will be learning valuable lessons in observing natural objects. We have no fault to find with the illustrations, which are beautiful, and generally, when original, accurately, as well as artistically drawn, while those which are copied from the best entomological artists, are faithfully done; some, however, are evidently electrotypes from Harris, Riley, etc. We notice an error on page 11. The spinneret, in caterpillars, is situated on the *under* not the *upper* lip, the silk glands passing into the floor of the mouth and opening through the labium. We heartily endorse the advice to those beginning the study of insects that "we should not begin with statistics—studying how many thousands of moths and butterflies there are supposed to be, or how many species of insects have been classified and named. Take 'one to begin,' as children say, and study it thoroughly."

GRABER'S INSECTS.[2]—We have already drawn attention to the first two parts of this admirable work, and the commendations then bestowed upon it will apply to the present part. The biology of insects is concluded by chapters relating to the reproductive habits of insects, parthenogenesis and certain anomalous modes of reproduction, and to their powers of destruction. The author evidently belongs to the German ultra-Darwinian materialistic school, and claims, to use his own words, that: "It is the grand, free idea of the present age, which acknowledges the existence outside of and above nature of no power *and in general no being*, that all existing, all physical and psychical phenomena may be explained by the active causes in nature, and that the individual is not necessary for the preservation and harmonious develop-

[1] *Insect Lives, or Born in Prison.* By JULIA P. BALLARD. Cincinnati, Robert Clarke & Co., 1879. Sq. 12mo, pp. 97. $1.00.

[2] *Die Naturkräfte.* Eine naturwissenschaftliche Volksbibliothek. XXII Band, 2 Hälfte. Die Insekten. Von Dr. VITUS GRABER. II Theil, 2 Hälfte: Vergleichendes Lebens und Entwicklungsgeschichte der Insekten. Mit 127 original holzschnitten. München, Druck und Verlag von R. Oldenbourg. 1879. 3 marks.

ment of the whole, but all unitedly produced as the resultant of the coöperation of the individual powers of nature."

It is easy for the Austrian professor to give utterance to this dogma, but in the present state of our knowledge we doubt whether such a broad generalization (or narrow conclusion) can be supported by demonstrable facts, and we would urge that, as in human history so in that of the lower animal world, individual effort is all important; the success of certain favored individuals effecting and insuring a progress that ultimately dominates the whole mass of organized beings.

The instances which the author gives of the losses from insect depredations are of a mild order compared with those sustained in the United States, but on the whole the subject is treated in a comprehensive and interesting way. The illustrations of this part, though sometimes too diminutive and not always carefully engraved, are perhaps sufficiently clear for a popular work.

The last part is devoted to the embryology and metamorphoses of insects, and forms a fresh, well illustrated and most convenient treatise on the subject. The works of Weismann, Kowalevaky and others are freely used, and a good deal of valuable original matter introduced; the application of the germ-layer doctrines to insects, the novel illustrations of the embryology of different insects, in which work the author's former experience as a histologist and entomotomist has made him an adept, and the schematic drawings to illustrate the process of molting, and the formation of the pupa under the skin of the larva, these and other points appear to have been elaborated with a briefness and clearness of treatment which, with the previous anatomical part, will render the work a standard one for some years to come. Among the illustrations of hitherto unpublished embryological facts are cross sections of the embryo of the flesh fly, of the *Lina populi* beetle, the two diagrammatic drawings of the germ and its embryonal layers; of the embryo of Mantis, and the eggs of the swarm moth (*Liparis dispar*). The author has attempted to combine the results of different embryologists, and to clearly expound them for the use of the general student in a way which has not hitherto been accomplished. The portion on the metamorphoses of insects is treated in a way not wholly new to the American reader, but the matter, some of which is new, and the valuable and original figures of the longitudinal section of the puparium and enclosed pupa of a muscid fly, the section through the thorax of a Polistes wasp, through the head of a caterpillar, and through the thorax of the cabbage-butterfly are original and valuable.

Recent Books and Pamphlets.—The Genera of European Nemerteans critically revised, with description of several new species. By Dr. A. A. W. Hubrecht. (Note XLIV of the Leyden Museum. 8vo, pp. 193–232.) From the author.

Darwinism and other Essays. By John Fiske, M.A., LL.B., etc. 8vo, cloth, pp. 283. Macmillan & Co., London and New York, 1879.

Verlaufige Resultate fortgesetzter Nemertinen-Untersuchungen. Von Dr. A. A. W. Hubrecht. 8vo, pp. 3. (Ext. from Zoologischer Anzeiger, August, 1879.) From the author.

On the Extinct Species of Rhinocerid≈ì of North America and their allies. By E. D. Cope. 8vo, pp. 227–237. (Ext. from the Bulletin of the U. S. Geol. and Geog. Surv., Vol. v, No. 2.) Washington, Sept. 6, 1879. From the author.

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GENERAL NOTES.

BOTANY.

On the Habitat of Rhododendron catawbiense.—In the spring of 1878 I was informed that "laurel" grew in abundance a few miles from the State University, at Chapel Hill. As I was at that time unfamiliar with the flora, having but recently removed to North Carolina, my first thought suggested a species of Kalmia. In April I visited the locality—the northern exposure of a steep bank on Morgan's creek, some three miles from the village. Much to my surprise I beheld a dense growth, not of Kalmia, but of Rhododendron. The shrubs were from eight to fifteen feet in height and among the smooth green leaves were clusters of the most beautiful purple blossoms. Could it be *Rhododendron catawbiense* growing so luxuriantly at an altitude of only five hundred feet? I sent specimens to my friend, Prof. W. R. Dudley, of Cornell University, together with a description of the locality. In reply to my letter, he says: "I recognized them at first sight as this (*R. catawbiense*). * * They are indigenous only on the higher summits of the Alleghanies. We found them on the Black mountains last summer, but only above 6000 feet." Up to this time, I must confess, I had been somewhat in doubt as to the species, especially as the plant occurred in such an unusual situation, but after submitting specimens to so competent a botanist as my friend, who had studied the Rhododendron in its mountain home, all doubts were removed. Last spring a member of the university chancing to meet Prof. Gray, who was on a botanical excursion in Western Carolina, mentioned to him the fact that the laurel grew near Chapel Hill. Dr. Gray was evidently much astonished, and, having been informed of this, I immediately sent him a dried specimen and a description of the locality. He replied as follows: "The laurel (which I had heard of from one of your pupils whom I met in June) I am delighted to see. It is certainly, as you say, *R. catawbiense*, and most remarkable for occurring at so low a level, where it flowers early. It comes down somewhat as *R. punctatum* does in

[redacted]

Georgia. But this is *more remarkable.*"[1] It seems strange that the growth of this plant in the middle region of the State should have escaped the notice of that acute observer, the Rev. M. A. Curtis. That it did will be seen from the following, taken from his catalogue:[2]

"*Oval-leafed Laurel* (*R. catawbiense* Michx.).—This splendid laurel is chiefly confined to the highest summits of our mountains, but is said to extend somewhat into Virginia. It is often confounded with the preceding [*R. maximum* Linn.], but besides its different locality, growing only on the tops of such mountains as the Roan, in Yancey, and Negro Mt., in Ash, it blossoms earlier than the other, though at a higher elevation, has larger and more intensely colored flowers, and shorter and broader leaves. * * * * It stands cultivation pretty well in the middle district."

Since the above correspondence I have been informed that this plant grows luxuriantly on the north side of the Oconechee mountains (hills from two hundred to three hundred feet high), near Hillsboro, the home of the late Dr. Curtis, at an altitude of from seven hundred to eight hundred feet. Not only does it stand cultivation in the middle district *where it is indigenous*, but it seems to thrive in the lowland of the eastern part of the State. Plants may be seen at Tarboro, in Calvary churchyard, where they were planted many years ago by my friend, the Rev. Dr. Cheshire.—*Prof. F. W. Simonds, University of North Carolina.*

THE TWINING OF THE STEMS OF THE HEDGE BINDWEED, ETC.[3]—Several plants of *Calystegia sepium* (hedge bindweed) were faithfully studied, for some weeks, by S. W. Beaumont. It is generally stated that the stems of this plant ascend by coiling against the sun, or from right to left, as viewed from the outside. On a stalk of nettle were observed two vines twining in opposite directions.

By tracing these two vines, they were found to preserve their opposite directions for their entire length. Another plant had two branches starting near the root. Each of these branches, and every branch on these divisions throughout, preserved the same course. This was also found to be the case in a vine twining in an opposite direction. Experiments to induce vines to reverse their course proved of no avail. Straight stakes were placed in the ground for the vines to twine about. After arriving at the top, the vines fell or lopped over; some drooping slightly, some ascending. If the top of a plant is weak, the vine often leaves it before reaching the top. Sometimes the vine becomes

[1] Dr. Gray has kindly added a note on this point to an article in the Bulletin of the Torrey Botanical Club for July and August, 1879. See page 336.

[2] The Woody Plants of North Carolina, Raleigh, 1860, p. 97.

[3] Abstracts from papers of students of Michigan Agricultural College, made by Professor W. J. Beal.

twisted, but not always. The vines are quite slender, and often reach off from their support to a great length. One branch reached four feet and six inches, nearly in a horizontal position; another, five feet and three inches; another, nearly six feet. This last, like the rest, was a single vine, and at the largest place only a sixteenth of an inch in diameter. One branch, which reached out twenty inches, passed over a sixth of the circumference in three-quarters of an hour. Sometimes the vines can almost be seen to move. They appear to move most rapidly in the hottest part of the hottest days.

Mr. T. F. Millspaugh experimented with wild cucumber (*Echinocystis lobata*). He trained a plant on a straight upright stake. The vine grew erect until it was about fifteen inches above the stake, and then bent over at about an angle of 45 degrees. It gradually dropped to a horizontal position and grew four feet and nine inches beyond the stake. Then it turned, and began to grow back on itself down to the stake. Here it neither went up nor down, as we should suppose, but grew right on the other side of the tip of the stake, till, at the time of writing, it had gone twenty inches. Before the vine doubled back on itself it described a complete circle in one hour and forty-five minutes. It went fastest on one hot day, between one and three o'clock. Tendrils were made to coil by irritation of various objects. He examined fifty specimens of tendrils which had made coils. It is well known that when these become attached at the extremity, that they turn in one direction for a part of their course, and then turn in the opposite direction. In one tendril there were seven of these changes in direction; in two there were six changes; in six there were five; in eleven there were four; in twenty-three there were three; in five there were two, and in two there was one change.

Botanical News.—The *Bulletin* of the Torrey Botanical Club, for July and August, contains interesting notes of a botanical excursion into North Carolina, by J. H. Redfield, to which Prof. Gray contributes foot-notes. The discovery of *Epipactis helleborine*, var. *viridans* Sim., in the vicinity of Syracuse, N. Y., by Mrs. Church, a member of the Syracuse Botanical Club, is recorded. To the September number Mr. C. F. Austin contributes some bryological notes.——In the *Botanical Gazette* for October, Prof. Gray draws attention to Poisson's account of the beheading of flies by *Mentzelia ornata*, the victims being caught in the barbs of this plant. The flies, attracted by the viscid matter in certain of the bristles, "thrust in their proboscis between the thickly set glochidiate bristles to feed upon the secretion of the glands between and below. The retrorse barbs interpose no obstacle to this; but when the proboscis is withdrawn, its dilated and cushion-like tip catches in the barbs, and holds all fast. The harder

the backward pull, the firmer and the more extensive the attachment to the sharp barbs; the wounded and impaled organ becomes congested and swollen, and the insect is seldom able to disengage it. Especially is this the case with the larger flies. Some perish by exhaustion, but more of them, passing round and round in a circle and in one and the same direction, come to an end by twisting off their heads!"——Trimen's *Journal of Botany* for October, gives us a note on borage, by H. F. Hance, of interest to American botanists.——Prof. P. von Tieghem has succeeded Brongniart as Professor of Botany at the Museum at Paris.——In Caruel's *New Italian Botanical Journal*, is an article on the morphology and biology of freshwater algæ allied to Nostoc, etc., by A. Borzi.

ZOÖLOGY.[1]

NOTES ON SOME REPTILES AND BATRACHIA OF THE PACIFIC COAST.—The large frog (*Rana temporaria* var. *aurora*), sometimes called "bull-frog," of this coast is eaten in considerable quantity in San Francisco. Its consumption is not confined to Frenchmen, at whom some rude people are apt to scoff as "frog-eaters," but extends to some individuals of the beef-eating nation, as well as to Americans and those of other nationalities.

The real bull-frog is much larger than our species, yet a large specimen of the latter reaches the very respectable length of five and a-half inches from the nose to where the tail of his tadpole days commenced. Such large frogs are by no means cheap delicacies, since they are retailed at four dollars per dozen. The smallest I have yet seen in the market were worth one dollar and seventy-five cents per dozen. And there is reason for the high price.

Ponds and brooks margined or partly overgrown with water-weeds, such as frogs love, are scarce in the vicinity of San Francisco, and most of those which occur have been to a great extent depopulated of their croaking inhabitants long ago.

Those brought to market are caught in Marin county, in brooks and boggy places beyond San Rafael; in San Mateo county; even as far away as Visalia, which, from its position in what is known as the "Four Creek Country," would seem to be especially fitted for their production.

Two or three Frenchmen are the only people who systematically make it their business to catch these batrachian delicacies; and when we consider the long and toilsome journeys across rough country that these men have to perform, we cease to wonder that they are not cheap.

Chelopus marmoratus Baird and Girard. Out of about thirty-eight species of fresh-water turtles or terrapins found in the United

[1]The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES. U. S. A.

States, one only, known to zoölogists as *Chelopus marmoratus*, is, so far as I am aware, found in California, and is the terrapin of our markets.

Terrapins were once common in the creeks and ponds around the bay, but the constant demand for their flesh has made them scarce, so that the present supply comes from the region around Sacramento, from Knight's Ferry, from Tuolumne county, and the southern part of the San Joaquin valley generally; as well as from the neighborhood of Visalia.

The dealers say that those from Visalia and from the San Joaquin are far superior to those from Sacramento. In the latter the under side is almost white, while in the former it is dark, approaching black; the latter will often die by the dozen soon after they are brought in for sale, while the former will keep alive for months.

A terrapin thus kept and not fed, gradually diminishes in weight, but is not injured in any other way. During its confinement it is really feeding on its own fat, and small as is the range of its activities, and gradual the waste ensuing from them, the results are obvious after a month or two; so that a terrapin kept six or seven months without food, though still alive, is little but shell, bone and skin.

Terrapin are abundant in the reservoir of the San Rafael water works, where, however, fishing is not allowed without permission. There are some in the basin of the fountain at Woodward's Gardens, and of these, having discovered that small lumps of dirt thrown at it while sunning itself on a rock do not hurt it, declines any more to dive under these provocations, and simply cranes its long neck to see what is the matter.

Heloderma suspectum Cope. Several specimens of this large lizard have been presented to the California Academy of Sciences or to Woodward's Gardens during the past year. It attains a length of about eighteen inches, has a thick stout body of a bright yellow color mingled with brown, and it is of a most unattractive aspect, which doubtless accounts for its title of "Gila monster." It has the unenviable reputation of being a poisonous lizard, and although it has been proved not to be poisonous by experiment, as there is not in nature, so far as is known, such a thing as a poisonous lizard, yet the idea is based on a better foundation than that of most popular beliefs, for, as I am informed by Prof. Cope, the front teeth are grooved and there is a gland at the base. For this reason Prof. Cope named it *suspectum*, and he appears to think that after all he would prefer to be bitten by some other kind of lizard.

The Gila monster is slow in its motions, and when pursued will stop and show fight in a feeble sort of way—peculiarities which, together with the large size and conspicuous color, render it easy to be captured, and it is not unlikely that it will ere long

become extinct, as it is killed wherever found. It would be interesting to know what this large, slow-moving lizard finds to live upon in the arid wastes of Arizona.

Chirotes. The curious "hand-eared lizard," which, lizard though it is in structure, would look exactly like a snake were it not for two curious little limbs placed close to the head, has been found in Lower California, a district which, as regards its reptilian fauna, is more properly included in the Nearctic or North American region than in the Neotropical or South American.

No mention is made of this species in the check-list of Nearctic reptiles drawn up by Prof. Cope, and published by the Smithsonian Institution, but two specimens were obtained at La Paz by Mr. Turner, U. S. Consul at that place, and presented to W. I. Fisher, of San Francisco; and Prof. Cope informs me that a European herpetologist has also obtained some from Lower California.

Chirotes belongs to the Amphisbænia, which are characterized by a thick short tail, inconspicuous rudimentary eyes, and a body surrounded (as is also the tail) with numerous rings of small square plates. All the genera except Chirotes are destitute of limbs, and as they have the power of moving backwards, are popularly regarded as poisonous snakes, possessed of a head at each end of the body. The two little legs, each furnished with five toes ending in pointed claws, save Chirotes from this imputation.

The hand-eared lizard is about eight inches long with about two hundred half-rings of small, square plates on the back and a smaller number of half rings of similar but larger scales on the belly. Along the side, where the rings of back and belly meet, are some small triangular scales filling in the interstices.

The mouth is very small, the few plates on the top of the head not conspicuous, the eyes scarcely discernible, and the neck of the same thickness as the body, which is about the calibre of a lead pencil.

Aniella pulchra Gray. This little snake-like creature is entirely destitute of limbs, and is, therefore, usually regarded as a snake, but the structure of the head is lacertian, and it is classed among the Lacertilia. It is the only species of its family, the Typhlopidæ, found in North America, and is probably confined to the southern part of the Pacific region. The Typhlopidæ are burrowers, with very small eyes and a blunt tail, in these respects resembling the Amphisbænidæ, but they differ from that family in the character of their covering, which is formed of small diamond-shaped scales instead of regular rings of square or oblong scales.

Aniella pulchra appears to be dug up with tolerable frequency southern parts of California, but is not found around San o. It is about eight inches long, slender, of a bright r above and light blue underneath, with a band of yel-

low along the center line of the back. A living example, domiciled in a cigar box partly filled with dirt, did not appear to be very active or very timid, as it would rest quietly upon the palm of the hand, and scarcely attempted to move away when touched. When placed upon the dirt in the box, however, it burrowed very deftly.—*W. N. Lockington.*

Anecdote of the Great Horned Owl.—Many years ago I observed a singular habit of the owl, a notice of which I have never seen published. In the "funny column" of our local newspaper, a paragraph appeared headed "How to kill an Owl," the substance of which was: after finding an owl on a post or tree, you were to have him fix his eyes upon you, and then walk rapidly around him; closing with the statement that he will keep his eyes so intently upon you, turning his head with your movements but forgetting to turn his body, that he will thus wring his own head off.

Nothing is too absurd for a boy to attempt if it promises fun or novelty; and shortly afterward a fine live specimen of a nearly adult *Bubo virginianus* falling into my hands, I proceeded to test the matter by experiment. I placed Bubo on the top of one of my mother's clothes line posts, where he remained motionless and entirely unconscious of the attempt about to be made upon his life. It was not difficult to secure his attention, for he never, while I had him, diverted his gaze from me while I was in his presence. I began walking rapidly around the post, a few feet from it, keeping my eyes fixed upon him all the while. His body remained motionless but his head turned exactly with my movement. Half way round, and his face was directly behind. Three-quarters of the circle, and still the same twist of the neck, and the same stare following me. One entire circle, and no change. On I went, twice round and still that watchful stare and steady turn of the head. I had all this time kept uninterrupted watch of the bird. His talons grasped the top of the post, and his body was perfectly stationary. On I went, three times round, and I began really to wonder why the head did not drop off, when all at once I discovered what I had failed to notice before. When I reached half way round from the front, which was as far as he could turn his head to follow my movement with comfort, he whisked it back through the whole circle so instantaneously, and brought it facing me again with such precision, that I failed to detect the movement, although I was looking intently all the time. I repeated the experiment many times afterward on the same bird, and I had always to watch carefully to detect the movement of the readjustment of his gaze. So rapid and precise was this movement that I failed several times to detect it, even when I was looking expressly for it, and at the proper moment.—*C. A. W.*

NOTE ON THE NOMENCLATURE OF HESPEROMYS AMERICANUS COUES AND YARROW.—A note recently published in the Annals Mag. Nat. Hist., by Oldfield Thomas, Esq., "On Robert Kerr's Translation of the 'Systema Naturæ' of Linnæus," gives some important information respecting that rare and obscure book. It appears that, among the Mammalia, the species described in Pennant's History of Quadrupeds (1781), and Phillips's Voyage to Botany Bay (1789), here receive Latin names, forestalling those in Shaw's General Zoölogy (1800–1804).

Among such names are a number affecting North American species. Thus, *Lutra canadensis*, *Mustela americana* and *Didelphys virginiana* must be accredited to Kerr, 1792, not to Shaw or Turton, as we have usually done.

From a private note, kindly addressed to me by Mr. Thomas, it appears, among other things, that *americanus* Kerr, must be used instead of *leucopus* Raf., for the common American white-footed mouse, there being in Kerr, on p. 231, a certain *Mus agrarius americanus*, which is based on Pennant, Hist. Quad., No. 302 b. In their article on Mammals, in Vol. v. of the Wheeler quarto Report of the Survey west of the 100th meridian, Drs. Coues and Yarrow called the species *H. americanus* (Kerr); but afterwards, having meanwhile no opportunity of verifying the reference, Dr. Coues reverted to the use of *H. leucopus* Raf., in Monog. Rodentia, *Muridæ*, p. 50 (see also note (2) on p. 51).

Unless, therefore, some still earlier name be forthcoming, this mouse must bear that at the head of this article, and its subspecies, of which there are several, should be called *H. americanus sonoriensis*, *H. americanus eremicus*, *H. americanus gossypinus*, etc.—*Elliott Coues, Washington, D. C.*

THE FISHES OF KLAMATH LAKE, OREGON.—A collection made at various points on the Upper Klamath lake yielded eight species of fishes, as follows: 1. *Salmo iridea* Gibb. This trout is found abundantly in the lake, as well as in the streams tributary to it; e. g., Sprague river, Wood river, Crooked creek, Fort creek. It reaches a weight of ten pounds, and varies in color from white to red on the sides. 2. *Salmo spectabilis* Gird. The Dolly Varden is less common than the *S. iridea*; the only locality from which I procured it is Seven Mile creek, near Fort Klamath. 3. *Chasmistes luxatus* sp. nov. This is a large fish, and with its congener below named, of no little interest, as extending the range and characters of Jordan's little-known genus *Chasmistes*. Form elongate, head long, flat above, and with a large fontanelle. Mouth terminal, the spines of the premaxillary bones projecting so as to form a hump on the top of the snout. Lower lip a very thin dermal fold, extending entirely around the chin. Scales 12–80–9; radii D. 11, A. 9. Color clouded above with punctulations; below paler, with red shades in some speci-

mens; fins uncolored. It attains a length of nearly three feet. It ascends the streams in thousands in the spring, and is taken and dried in great numbers by the Klamath and Modoc Indians. The former call it Tswam. 4. *Chasmistes brevirostris* sp. nov. This fish does not exceed 14–16 inches in length, and has a differently formed head and muzzle from the *C. luxatus*. They are shorter, especially the muzzle, and the latter is without the hump produced by the protuberant premaxillary spines. Parietal fontanelle small. The lower lip-fold is only present at the sides of the mandible. Body nearly cylindric. Scales 12–74–11; radii, D. 11, A. 9. Color dusky above, silvery below; fins colorless. This fish is abundant in the lake, but I was informed by a Klamath Chief, that it does not ascend Williamson's river in spring with the *C. luxatus* and *Catostomus*. Klamath name Xoōptu. 4. *Catostomus labiatus* Gird. Very abundant; Yehnne of the Klamaths. 5. *? Mylopharodon* sp. Not certainly of this genus, and resembling the genus *Anchybopsis*, found fossil in the Idaho and Oregon Pliocenes. I was interested to find this species quite abundant. I am not yet able to ascertain whether the present species is one of those already named or not. 6. *Gila*. A species of medium or small size, and rather robust proportions. 8. *Uranidea*. Undetermined; a stout species, and very abundant.—*E. D. Cope*.

New Classification of the Crustacea.—The recent studies on the embryology of the king crab (*Limulus polyphemus*) has shown that there are some unexpected resemblances to the mode of development of the Arachnida, and while in our essay[1] on the development of this Crustacean we attempted to show that the arachnidan features were also to be found in certain crabs and shrimps whose development was exceptional, one or two naturalists, as E. Van Beneden and Dohrn, claim that Limulus is not a true Crustacean, but belongs next to or with the Arachnida. This seems to us an extreme view. Then followed the beautiful anatomical researches of Alphonse Milne-Edwards on *Limulus polyphemus*, in which he showed the singular relation between the vascular and nervous systems; the latter being enveloped by the ventral system of the arteries. The differences between the nervous system of the king crab and Arachnida has been already indicated.[2] It has not been, we think, sufficiently taken into account that Limulus is a generalized or synthetic type, combining with features of its own, certain resemblances to the Arachnida and to the normal Crustacea. In its mode of respiration, its external gills, and in its circulatory organs it is, as we have previously stated,[3] essentially a Crustacean, but should be placed

[1] The Development of *Limulus polyphemus*. By A. S. Packard, Jr. (Memoirs of the Boston Soc. of Nat. Hist.) Published March, 1872.

[2] American Naturalist, Vol. 9, p. 422, 423. July, 1875.

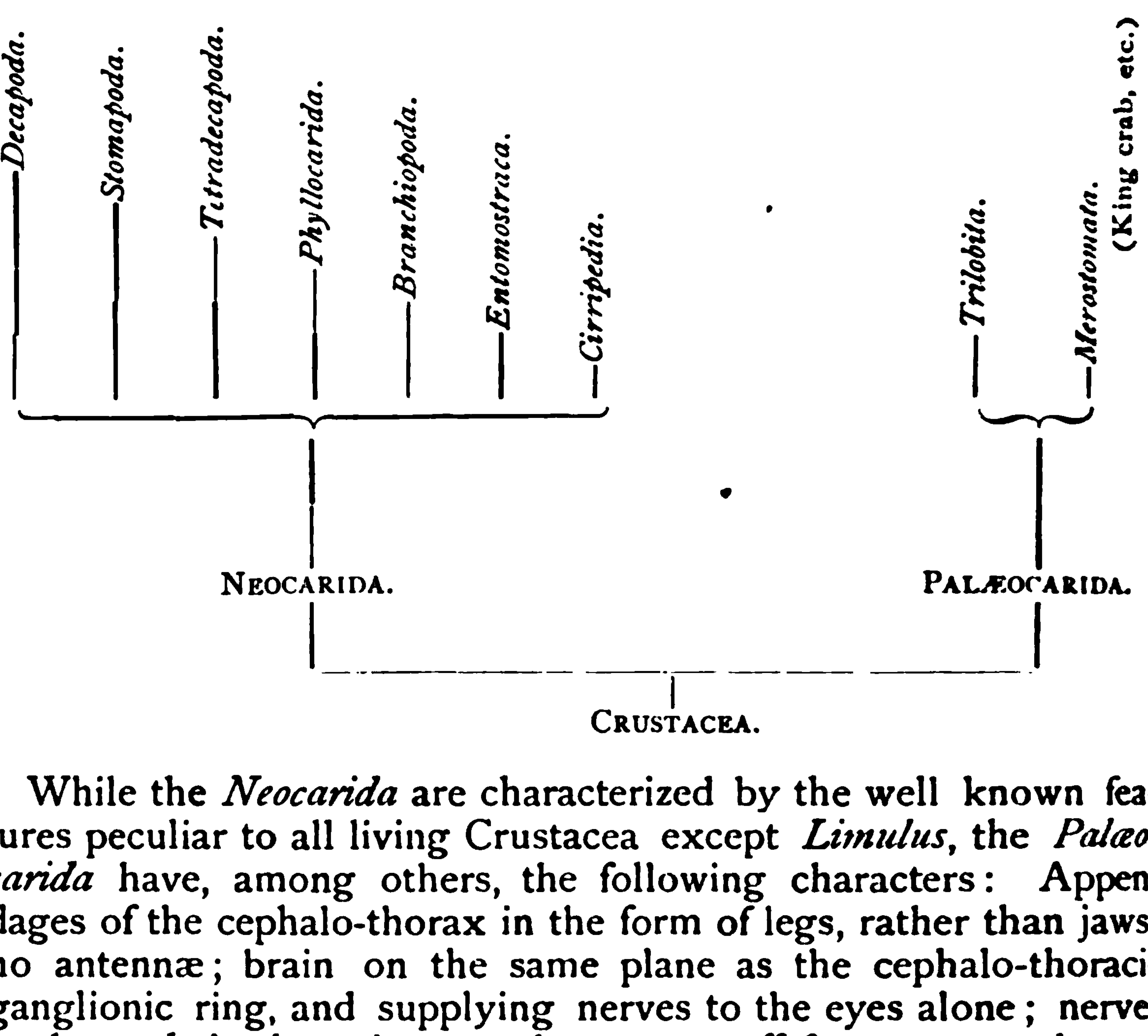
[3] Farther Observations on the Embryology of Limulus, with notes on its affinities American Naturalist, Nov., 1873, Vol. 7, p. 675.

apart from the normal Crustacea, and form the living representative of a subclass, equivalent to all the other living Crustacea. To Limulus are closely allied the fossil Merostomata; and we regard, for reasons already stated, the Trilobites as closely allied to the Merostomata.

For this subclass we have proposed the name *Palæocarida*, and for the normal Crustacea we have proposed the term *Neocarida.*

In order to express the relations of the two subclasses of Crustacea, we have published[1] the following table showing the mode of grouping of the different orders of the two subclasses of the class of Crustacea:

CLASSIFICATION OF THE SUBCLASSES AND ORDERS OF CRUSTACEA.



While the *Neocarida* are characterized by the well known features peculiar to all living Crustacea except *Limulus*, the *Palæocarida* have, among others, the following characters: Appendages of the cephalo-thorax in the form of legs, rather than jaws; no antennæ; brain on the same plane as the cephalo-thoracic ganglionic ring, and supplying nerves to the eyes alone; nerves to the cephalo-thoracic appendages sent off from an œsophageal ring; nervous system ensheathed by a ventral system of arteries; metamorphosis slight. Sexes distinct.

Order 1. *Merostomata.*—No distinct thoracic segments and appendages. (Limulus, Eurypterus, etc.) *Order* 2. *Trilobita.*—Numerous free thoracic segments and jointed appendages. (Agnostus, Paradoxides, Calymene, Trinucleus, Asaphus, etc.; all extinct.)

A farther elaboration of this classification, with full references

[1] Zoölogy for Students and General Readers. American Science Series. By A. S. Packard, Jr. H. Holt & Co., New York. Published in Dec., 1879. 8vo, pp. 703.

to the labors of others, is to be given in a second memoir on the anatomy and development of *Limulus polyphemus*, in course of preparation.—*A. S. Packard, Jr.*

Zoölogical News.—A number of papers on the Hymenoptera and Coleoptera of the United States, by Messrs. E. Norton, C. A. Blake and Dr. Horn, are in course of publication in the Transactions of the American Entomological Society of Philadelphia.——A detailed and fully illustrated account of the development of *Palæmonetes vulgaris*, by Mr. Walter Faxon, appears in the *Bulletin* of the Museum of Comparative Zoölogy.——Mr. S. H. Scudder, of Harvard University Library, Cambridge, has nearly ready for publication by the Smithsonian Institution an index to all genera hitherto proposed in zoölogy, whether for recent or fossil animals. It is to be based upon the "Nomenclators" of Agassiz and Marschall, and the indexes to the Zoölogical Record.——Prof. Allen Thompson, in *Nature*, confirms the statement that the scorpion commits suicide by stinging itself in the middle of the top of its head.——The early stages of the Cœcilians, or blind snakes, have recently been discussed by Peters, according to *Nature*. An observer in Cayenne saw, according to Herr Wrzensniowski, of Warsaw, a female *Cæcilia compressicauda* give birth, in water, to two young ones alive. The Russian observer, on receipt of the alcoholic specimens, found in the oviduct five more young ones. The young had no trace of lateral gill openings like those discovered in *Epicrium glutinosum* of Ceylon, but it has external bladder-like gills, like those of *Notodelphys ovifera*. Hence these blind amphibia should, when young, be looked for in water. *Cæcilia oxyura* has branchial clefts but no external gills, while *C. rostrata* of the Seychelles has neither branchial clefts or a swimming tail, or any scars showing the former presence of external gills.

ANTHROPOLOGY.[1]

Anthropological News. — The following vocabulary of the Caddoquis, or Caddo, language was received from Judge J. F. H. Claiborne, of Natchez, Miss., who writes, "It was prepared and sent to my uncle, Gov. Claiborne, of Louisiana, by Dr. Sibley, agent for the Caddos, an educated gentleman. The southern Indians held this tribe in great respect for its supposed antiquity. It was known as the Father tribe."

Among the Smithsonian Comparative Vocabularies, now in charge of Major J. W. Powell, is a short one of the Caddo, No. 444, by Dr. D. J. Macgowan, taken in 1865.

All that remains of this once flourishing tribe are gathered on the Witchita agency, in the Indian Territory. The agent, Mr. A. C. Williams, reports their numbers at 467 persons, principally

[1] Edited by Prof. Otis T. Mason, Columbian College, Washington, D. C.

engaged as farmers and stock-raisers. They are a quiet and inoffensive people, most of whom have adopted the habits of civilized life.

Dr. Sibley's vocabulary was taken in 1804, when the Caddos were located on Red river, from Alexandria to Natchitoches, and follows the French orthography:

Fire, niquor
Water, cou cou
Earth, ouadat cequeteot
Air, yanour
Wind, havetour
Sky, quarchator
Sun, faquor
Moon, nis
Star, suoquas
Light, binaquor
Darkness, dasquoee
Day, nayañon
Night, naba
Heat, atedot
Cold, acourdot
Smoke, cousour
Cloud, carchavesa
Fog, cou sour quabariou
Rain, quaveour
Snow, ijna
Hail, tarsour
Ice, quitousour
Frost, devchea
Dew, cabariou
Rain-bow, nachnuvoin
Thunder, adenine
Lightning, avoidgnauia
Yesterday, nieschur
To-day, douria,
To-morrow, cearia
A day, ouiche deschar
A month, ouiche nis
A year, ouiche adavyour
Spring, asnis
Summer, yaar caades
Autumn, nibba
Winter, chei
Man, chouve
Woman, nateg
Boy siarches
Girl, nategches
Child, anin
Father, a-sin
Mother, sasin
Brother, nayin
Sister, dardin
Husband, arnouu
Wife, danayei
Son, anin quarcounté
Daughter, natichetez
The body, catocse
Head, quantour
Hair, bahat
Beard, sounnieites
Face, chanqua'er
Eye, chaor
Nose, souour
Cheek, chaminni
Chin, soun
Mouth, lip, ouar
Tooth, taor
Tongue, adetour
Ear, bistor
Neck, nachée
Arm, minni
Wrist, a
Hand, cenour
Finger, cebinour
Belly, binni
Back, chabaches
Side, quocher
Bubby, dantour
Nipple, dante echanqua
Thigh, quasour
Leg, casosce
Foot, nasour
Toe, senbitour
Skin, nousches
Nails, ceonour
Bone, narquour
Blood, baor
Life, quava
Death paquaca
Food, deace nouyour
Meat, quaoutour
Fat, acayou
Lean, nargou
Bread, dasquat
Indian-corn, quaces
Milk, sou-sou
Egg, nosbiquor
House, sahor
Mammoth, douriates
Buffalo, tanaa
Elk, oueyat
Deer, da
Bear, naoeches
Wolf, tacha
Panther, quiches
Wildcat, ouado
Polecat, vueiet
Fox, couons
Beaver, chestaor
Raccoon, hot
Opossum, narcous
Hare, diot
Squirrel, siouar
Flying-quirrel, detes.

Ground-squirrel, chiouva aquared
Mole, cequouva
Bird, banit
Eagle, ioy
Hawk, souit
Owl, ouous
Turkey, nou
Swan, sartos
Wild-goose, quinar
Duck, can.
Turkey-buzzard, souquates.
Raven, ouvar
Crow, caquail
Black-bird, quacho
Crane, douno
Pigeon, ouáas
Pheasant, ounani
Partridge, colati
Mocking-bird, quathile quatou
Red-bird, laodoucé
Snake, quiqua
Lizzard, taquon
Butterfly, banous
Fly, quouni
Fish, bata
Frog, quidau
Gold, sounar aquayguo
Silver, sounar aquayou
Copper, dedot noustor
Stone, siguor
Wood, youcour
Gum, guaruoadat
Mountain, ouadat iniquo
Hill, chuquaet
Valley, nicquedaic
Sea, eiquot aicmaie.
Lake, eiquot
Pond, quanmachar
River, baat
Creek, nidday quayarda sar
Spring, quayardacha
Grass, adeitour
Tree, quardacha
Pine, devoas
Cedar, betes
Sycamore, quiour
Ash, quiquor
Elm, da auve
Beech, aligonqua danquone
Birch, saibatocha
Oak, ba
Chestnut, nouba
Hickory, nar
Walnut, sciar
Locust, danani
Mulberry, baie
Vine, sasour
Tobacco, yaar
Joy, quavrinout
Sorrow, gouienout
One, gauenie
Two, bit
Three, daauo
Four, evui
Five, de cequan
Six, danqui
Seven, bi cequan
Eight, daauo cequa
Nine, ivui cequa
Ten, benaar
Eleven–twenty, the numerals double
Twenty, benar bit
Thirty, benaar daauo
Forty, benaar evui
Fifty, benaar decequan
Sixty, benaar danqui
Seventy, benaar bicequa
Eighty, benaar davuecequa
Ninety, benaar ivuicequa
Hundred, ouiscbe aa sour
Two hundred, carquaniauosit
Horse, detama
Dog, deches
White, aquayou
Black, adeguo
Green, barnou sar
Blue, a sarquour
Yellow, aquaij quo
Red, atenou
Good, hanhat
Bad, avouna
Large, quarquavevour
Small, ayortetes
High, ayou
Low, naver,
Narrow, sidites
Old, anistes
Young, siarte
New, souroun
Hard, aiequai
Soft, achounou
Sweet, abe save
Sour, abasquo
Bitter, aquocho
Hot, atedos
Cold, acourdas
Dry, adaqui
Wet aquarquo
Strong, adasquar
Weak, aicquaie quoiace
Pretty, hanhat
Ugly, aouna
Sick, auequarion
Brave, ches soues
Cowardly, che inij inij
Wise, ouin anet
Foolish, quarnous quourdetaui
I, quarches
You, naquaya
He, deer
She, annas
They, davre
This, deschez
That, dèhe
To eat, naquiar
To drink, naquarqua

To sleep, youdic
To laugh, saqua
To cry, nasaquaqua
To sing, yourneiyoeu
To whistle, youdanou
To smell, nasoeunout
To hear, youquaibe
To see, nasaibe
To speak, nasacoupinte
To walk, nasavear
To run, nasaninic
To stand, daarni
To sit, dataue
To lie down, darsa
To smoke a pipe, darquavra
To love, sendamane
To hate, atedo ciyer
To strike, younbin
To kill, youques
To dance, youvechan
To jump, avesaria
To fall, navvania
To break, yoniouva
To bend, darquven
Yes, aaie
No, aounna

Mr. James E. Rhoads, of Germantown, Philadelphia, also sends us a translation of the Lord's Prayer in Comanche, made two years since by Frank Maltby, an employé at Kiowa and Comanche agency, near Fort Sill, I. T.:

THE LORD'S PRAYER.

MATT. VI. 9–13.

Our Father, which art in heaven,
Täh Afpä, pĕrkūne tömōvăt,
Hallowed be Thy name,
Mohoits sūicŭt Uh nănia,
Thy kingdom come,
Pun'tht pĕrnĕ'mänärk tăm'ŭcrĕckin,
Thy will be done on earth, as it is in heaven,
Täh sö'kōnäk Uh pee pŭn'tūne mahăn'ĕn, Uh pĕrkūne hiäōwite,
Give us this day our daily bread,
Icistse tăbă nĕmĕmăhk nĕmĕtĕhkărō,
Forgive us our debts, as we forgive our debtors,
Tähn hōcōniht nĕmĕsutine, Un hiătănă'sūtiwite tăhsuti'ne,
Lead us not into temptation, but deliver us from evil,
Tähkesŭäfpit kä tätshockăwite, kăsŭă tähn wĕărō,
For Thine is the kingdom, and the power, and the glory, forever. Amen.
Un simōyĕrōkăwect pŭnicks hin nämăhcōcŭt, ter hin hanit, ĕrie naniavi, kănăc-kämiwitĕ. Soonĕnähăn.

The Fifteenth Bulletin of the United States National Museum contains the report of several naturalists upon the scientific results of the Howgate Expedition. Mr. Ludwig Kumlien, naturalist of the expedition, contributes a paper consisting of fragmentary notes on the Eskimo of Cumberland sound. There will be found enough of mythology and linguistics in the contribution to repay perusal.

Two works on the ancient races of America are advertised under the following titles: "Footprints of Vanished Races in the Mississippi Valley; being an account of some of the Monuments and Relics of Prehistoric Races scattered over its surface, with suggestions as to their origin and uses. By A. J. Conant, A.M. C. R. Barns, St. Louis, Mo. $1.50." "The North Americans of Antiquity; their Origin, Migrations and Type of Civilization considered. By John T. Short. Pages 530. Harper & Brothers, New York."

GEOLOGY AND PALÆONTOLOGY.

THE CAVE BEAR OF CALIFORNIA.—In exploring a cavern in the Carboniferous limestone of Shasta county, Cal., James D. Richardson discovered the skull of a bear beneath several inches of cave earth and stalagmite. The specimen is in a good state of preservation, and demonstrates that the cave bear of that region was a species distinct alike from the cave bear of the East (*Ursus pristinus*), and from any of the existing species. In dimensions the skull equals that of the grizzly bear, but it is very differently proportioned. The muzzle is much shorter, and is wide, and descends obliquely downwards from the very convex frontal region. It wants the large postorbital processes of the grizzly, but has the tuberosities of the polar bear (*U. maritimus*), which it also resembles in the convexity of the front. Sagittal crest well developed. Three (one median and posterior) incisive foramina: three external infraorbital foramina. The teeth are large, and the series presents the peculiarity of being without diastema. The crowns of the premolars are not preserved, but if there were not three premolars, the second tooth has two well developed roots. First true molar with but two external and one internal tubercle. The absence of diastema renders it necessary to separate this bear from the true *Ursi*, and I propose to regard it, provisionally, as a species of *Arctotherium* Gerv. The canine teeth are large and compressed at the base. Length of cranium along base from below apex of union to premaxillary border, m. 0.387; length to posterior nares, .202; elevation of forehead vertically above the posterior extremity of the last molar, .141; width between inner border of posterior molars, .076. The species may be called *Arctotherium simum*.—*E. D. Cope.*

GEOGRAPHY AND TRAVELS.[1]

THE SWEDISH ARCTIC EXPEDITION.—An account of the voyage of the *Vega* up to August 27, 1878, at the mouth of the Lena river was given in our number for February last. After separating from the *Lena* they steered north-east toward the most southern of the New Siberian islands. These islands are remarkable for the numerous remains of the mammoth and a great quantity of coeval animal forms, which are found on them more abundantly than in the Tundra of the continent. A really thorough scientific examination of these islands has yet to be made.

Continuing on their course in the ice-free channel along the coast they reached the Baranov islands on the 3d of September. From here they passed through dense masses of floating ice until the 28th, when they were finally beset near the East cape, at Koljutschin bay 67° 6′ N. and 173° 15′ W., where they passed the winter. From letters from Prof. Nordenskiöld and from the

[1] Edited by ELLIS H. YARNALL, Philadelphia.

correspondence of the New York *Herald*, we learn that the winter was a severe one; intense cold with constant north-west winds, with only rare intervals of mild weather, was experienced. Snow-storms were of almost continual occurrence. Three camps of Tschuktschi were on the shore near their anchorage. These savages possess many excellent traits. They are amiable, obliging and peaceable, both among themselves and towards strangers. Their complexion is a brownish-yellow, hair and eyes generally black. The features are less Mongolian in type than are those of the Esquimaux, or the other indigenous tribes of Siberia. The men are tall and the young women often of perfect symmetry and fine proportions. They trade frequently with the American shore, which is accessible in winter and summer over ice or the open sea. They live in tents, dress in skins and subsist on seals, reindeer, bears, fish and vegetables. The women are tattooed on the face. The language spoken by this tribe is peculiar, and so far shows no affinity to others. A lexicon of 300 words has been made by Lieut. Nordqvist.

During the whole period that the *Vega* remained at Koljutschin bay, hourly meteorological and magnetic observations were taken. The months of March, April and May were very cold. In June the temperature became more supportable. From the very slight rise and fall of the tide, Prof. Nordenskiöld believes the sea north of Behring strait must be small, and is probably circumscribed by islands between Wrangel land and the archipelago of which Prince Patrick's island is the most western now known. No sickness occurred on board, owing, doubtless, to an abundance of good provisions, including a little fresh meat even in the severest months, good discipline and the superior physique of the members of the expedition. The advancing spring brought large flocks of birds; many of these are supposed to winter in Japan and others in North America. Dr. Stuxberg has sent to the Academy of Science in Stockholm, a preparatory memoir regarding the numerous specimens collected by the dredge, during the voyage, of Crustacea, Echinodermata and Crinoida. Some are of extraordinary size and not previously known. This portion of the Arctic sea, though comparatively poor in Algæ, afforded many specimens corresponding in the western portion to the European and in the eastern to the Pacific varieties. Large collections of mosses and lichens were also made. The northern lights never attained the brilliancy observable in Scandinavia.

Nordenskiöld calls attention to the difference in the coast east to that west of the Lena: "On the western side the country rises northward almost to the 78°, or to a latitude exceeded in very few places on the Polar sea, and where we may generally fear to encounter impenetrable masses of ice. On the eastern side the coast slopes gradually southward, and the sound which

unites the waters of the Arctic sea with those of the Pacific ocean is situated south of the Polar circle, or in about the same latitude as Haparanda.[1] On the western side the coast stretches out in a wide, treeless Tundra, while on the other side the forest boundary between the Lena and Behring strait extends in many places nearly to the coast. On the western side the coast lines are very incorrectly represented on the charts, so that we have sailed over a surface of nearly five hundred kilometres laid out as land on the latest maps of Siberia. But we have not been able to discover any considerable errors in the charts of the eastern coast."

On July 18th they were at last set free and entered Behring strait, and after stopping at Saint Lawrence bay, Port Clarence and Saint Lawrence island, they visited Behring island, where remains of the gigantic animal, *Rhytina stelleri*, exist, and bones sufficient to constitute several almost perfect skeletons were obtained. On the 2d of September, 1879, the *Vega* arrived safely at Yokohama, Japan.

While the north-east passage has thus been made successfully, it is doubtful whether the commercial results will be very important. The time during which the channel thus shown to exist, remains open, it is to be feared is too brief, and the risks of navigation too great, to afford much encouragement to the merchants of San Francisco to open trade with Siberia, as suggested by M. Siberiakoff in a letter to the New York *Herald*.

The commerce that was springing up on the western side from Europe, through the Sea of Kara to the Obi and Yenisei, has received a serious check this summer, as none of the six steamers attempting the voyage have been able to penetrate the ice which has obstructed the approaches to the Kara sea.

Not the least remarkable incident in the voyage of the *Vega* was the audience given the explorers by the Mikado of Japan and the honors paid them by the Tokio Geographical Society, the Asiatic Society of Japan and the General Asiatic Society at a banquet, at which the President of the Geographical Society, a prince of the imperial blood, presided.

Petermann's *Mittheilungen* for May, 1879, contains a valuable article, by M. Lindeman, on the north coast of Siberia, from the mouth of the Lena to Behring strait and is accompanied by an excellent and very detailed map in two sheets. An account of the authorities relied on, and the sources of information regarding this region used in preparing this map is given by the author, B. Hasentine, in the number for June.

PROCEEDINGS OF THE GEOGRAPHICAL SECTION OF THE BRITISH ASSOCIATION.—The British Association for the Advancement of Science held its forty-ninth meeting at Sheffield, from the 20th to

[1] At the head of the Gulf of Bothnia.—*Editor.*

the 27th of August. While the general attendance was much smaller than usual, the Geographical Section, under the presidency of Mr. Clements R. Markham, and favored with the presence of several distinguished travelers from abroad, had large assemblages at all its sessions. Mr. Markham, in his opening address, treated of the objects and aims of geographers and the position which the science holds, relatively, with reference to other sciences, and positively as a distinct body of knowledge with definite limits.

"We are still very far indeed," he said, "from an accurate scientific geographical knowledge of even the most civilized countries, while by far the largest portion of the earth's surface is inadequately surveyed, and a smaller, though far from inconsiderable, part is unsurveyed or entirely unknown. In the division of labor, the geodetist produces the accurate large-scale maps which are necessary in thickly populated countries, the topographical surveyor furnishes less exact maps of more thinly peopled and less civilized regions, while the trained explorer forces his way into the unknown parts of the earth.

Accurate maps are the basis of all inquiry conducted on scientific principles. Without them a geological survey is impossible; nor can botany, zoölogy or ethnology be viewed in their broader aspects unless considerations of locality, altitude and latitude are kept in view.

The surveying and mapping of the ocean is only second in importance to that of the land; and this work also divides itself into three sections, namely: the coast surveyed, the coasts partially surveyed and the unsurveyed coasts. Hydrography will not be completed until all the coasts in the world are included in the first section, which is now very far indeed from being the case. He had spoken of the measurement of the surface of land and sea, and of their heights and depths; to the mapping of the world and to the innumerable uses of maps and charts. But this only forms the skeleton of our science, which is endued with flesh and blood, with life and motion by those who study the causes and nature of the changes that have taken place and are now taking place upon the earth; by comparative and physical geographers, by those who study and classify natural phenomena, and demonstrate their connection with each other and their places in the great scheme of nature. The importance of the study of history and of early narratives for the elucidation of points in physical geography will appear from the consideration of a few instances. Take, for example, the great and fertile basin of the River Ganges, in India. The Sanscrit historian finds reason for the belief that in 3000 B. C. the only habitable part of the alluvial plain of India was the water-parting or ridge between the Sutlej and the Jumna. The rest was a great estuary or arm of the sea. It has only been fit for man's occupation within the historical period, and hundreds

of square miles of the delta have become habitable since the days of Lord Clive. The wonderful history of these changes can be traced by the student, who thus enables the geographer to explain the phenomena which he observes. Again, to pass to another part of the world. The student of history reads of the great sea fight which King Edward III fought with the French off Sluys; how in those days the merchant vessels came up to the walls of that flourishing seaport by every tide; and how, a century later, a Portuguese fleet conveyed Isabella from Lisbon, and an English fleet brought Margaret of York from the Thames to marry successive Dukes of Burgundy at the port of Sluys. In our own time if a modern traveler drives twelve miles out of Bruges across the Dutch frontier he will find a small agricultural town surrounded by cornfields, and meadows, and clumps of trees, whence the sea is not in sight from the top of the town-hall steeple. This is Sluys. A physical geographer will seek out the causes which have brought about this surprising change. They are most interesting, and most conducive to an intelligent comprehension of his science, and he will find them recorded in history. Thus the historian and the geographer work hand in hand, each aiding and furthering the researches of the other."

The second day's session was devoted to African exploration and papers by Maj. Serpa Pinto and Lieut. Savorgnan de Brazza on their recent journeys, were read. Of Maj. Pinto's journey, Com. Cameron remarked that it was one of the greatest ever made, his positions were accurately laid down and his observations were carried out in such a way as had never been done on any previous expedition, and when his book was published they would have a mass of scientific knowledge such as had rarely, if ever, been acquired in the same space of time and with the same limited amount of means at command.

Several important papers on Afghanistan were read, which had been prepared by officers and others with the English army during the war. Many explorations have been made in the unknown portions of this country, and the most important result is the destruction of the belief heretofore held that there were only three entrances into India on the north-west, and that if these passes were blocked up India was safe. It now appears, as stated by the president, that the whole country, from Jellalabad to the Bolan pass, could be crossed in any direction, and that the several roads were perfectly free and open grass plains except where they debouch on the Indian plains. The "scientific boundary," therefore, has no existence, and there must be a continuous frontier from north to south with lateral communications along it.

A paper on Arctic research, by Com. L. A. Beaumont, R.N., of the recent British Arctic expedition, advocated the prosecution of

the work by way of Smith's sound to the land around Cape Britannia. This involves the discovery of the northern side of Greenland. He prefers this route to an attempt along the eastern side because a higher latitude can be reached by Smith's sound, and he believed that a vessel might winter on the eastern shore of Robeson strait and advance depots to Repulse harbor in the autumn. Com. Beaumont, who has seen Cape Brittannia, the most northern known point of Greenland, believes that to stand on its highest peak would alone throw much light on Greenland geography.

A paper, by H. Rink, on "The Interior of Greenland" was read. This paper pointed out the principal feature, ice, in the interior of Greenland, and gave an account of the proceedings of recent expeditions for its exploration. The center of the country was stated to be a mass of movable ice. On this paper Com. Beaumont described a small tribe of people in the north of Greenland, cut off from all other peoples by glaciers. They hunted the seal, and would sit over a hole for three days in cold that would kill any other person. They were well disposed to Arctic explorers, but were dying out, two hundred only remaining of a once large tribe. The wonder of this people at seeing a ship was beyond all description.

A paper, by Lieut. Com. Wyse, on "The Exploration of the American Isthmus and the Inter-oceanic Canal" gave an account of the route selected by the recent International Congress at Paris. Adverse opinions to the scheme were expressed by Com. Cameron and other members.

MICROSCOPY.[1]

MICROSCOPICAL LABORATORY.—Dr. Carl Seiler, of Philadelphia, has opened a laboratory for the instruction of students in histology, pathology, and microscopical technology. A fee of $15 is charged for a course of twelve lessons. Microscopical examinations of pathological and other specimens will be made to order, and a large variety of histological and pathological specimens will be prepared for sale.

TRICHINA SPIRALIS.—Dr. Jas. A. Close, of Summerfield, St. Clair Co., Ill., is mounting specimens of this parasite in its different stages of development, by a modification of Beale's method, with considerable success. These difficult objects can be obtained from him by mail.

REMOVAL.—Wm. Wales has removed from Fort Lee, N. J., to No. 361 West 34th St., New York City. At this address he intends to keep a full supply of goods by Zentmayer, Beck and other makers, for the accommodation of those who may wish to

[1] This department is edited by Dr. R. H. WARD, Troy, N. Y.

examine and select at leisure, and with the quiet and comfort of a private residence. He will continue to supply his own lenses, unless other makes are preferred.

Ernst Gundlach.—This well-known optician announces another business change, by which he will devote his time exclusively to manufacturing, and L. R. Sexton, of Rochester N. Y., will attend exclusively to the department of business correspondence, selling goods, etc. He claims to have recently made great improvements in objectives and oculars, and to have invented an entirely new form of binocular arrangement, description of which is not yet published. He announces five styles or classes of objectives, as follows: Class A, triplets, consisting of a crown glass lens cemented between two flint glasses of different kinds, mounted in the back part of a tube, which has a diaphragm in front to cut off stray light; these triplets ranging from a 4 inch of 8 degrees to 1½ inch of 18 degrees. Class B, dialytic objectives, consisting of two separated achromatic combinations, arranged with special reference to flatness of field. These are of two grades; the first composed of two doublets, and ranging from a 4 inch of 10 degrees to a ½ inch of 40 degrees; and the second composed of two triplets, and ranging from a 2 inch of 24 degrees, requiring a microscope body with internal screw one inch wide, to a ½ inch of 36 degrees; these triplets can be separated, giving half of the same powers. Class C, aplanatic objectives, three system lenses, the front being a triplet, having large flat field, and chemical and visual foci nearly together, specially suited for photography, and ranging from a 1 inch of 26 degrees to a ¼ inch of 80 degrees. Class D, resolving objectives, three systems, and either dry, or glycerine immersion; the former varying from a ½ inch of 100 degrees, requiring an internal screw of one inch to a 1/8 inch of 130 degrees, and the latter from a ¼ inch of 115 degrees water angle, to a 1-16 inch of 120 degrees water angle. Class E, cedar oil immersions, four systems, with long working focus and high resolving qualities, varying from a ¼ inch of 140 degrees water angle, requiring an internal screw of 1 inch, to a 1-25 inch of 150 degrees water angle. Mr. Gundlach introduced at the meeting of the Rochester Microscopical Society, on the 13th of October, last, a "globe lens," consisting of a hollow sphere of flint glass, made in halves, and containing a solid sphere of Crown glass of certain proportionate density. A corrected lens is thus obtained, having long working focus in addition to the well-known advantages of the Coddington form. As yet they have only been made as pocket magnifiers.

SCIENTIFIC NEWS.

— The council of the Entomological Society of London are authorized by Lord Walsingham and other gentlemen interested in the diseases of British game-birds, to offer to public competition the following prizes: £50 for the best and most complete life-history of *Sclerostoma syngamus* Dies., supposed to produce the so called "gapes" in poultry, game, and other birds; £50 for the best and most complete life-history of *Strongylus pergracilis* Cob., supposed to cause the grouse disease. No life-history will be considered satisfactory unless the different stages of development are observed and recorded. The competition is open to naturalists of all nationalities. The same observer may compete for both prizes. Essays in English, French, or German to be sent in on or before October 15, 1882, addressed to the secretary of the society, 11 Chandos street, Cavendish Square.

— At the Sheffield meeting of the British Association, Dr. Crichton Browne delivered an address on influence of domestication on brain growth. He had found by experiments that domestication had greatly reduced the brains of the duck, and he argued that men, like ducks, might be fed and housed, fenced about, and exempted from participation in the life struggle until, like the ducks, they would depreciate in mental capacity. Their bodies might increase in size and succulence, but their brains would become straitened and withered. Disease and luxury crippled the brains. It was as true as ever that men were perfected through suffering, toil and conflict, and it was not through affluence and comfort that genuine civilization was attained. It was the civilization, not merely the domestication of mankind, that must be aimed at.

— Next to the name of Dr. T. W. Harris that of Dr. Asa Fitch will be held in especial remembrance for his valuable and numerous contributions to economical entomology. For many years before his death, which occurred April 8th last, at the age of seventy, he ceased to correspond with American entomologists, and to those of the present generation he was almost entirely unknown. A biographical sketch with a likeness, by E. P. Thurston, appears in the *Popular Science Monthly* for November.

— W. W. Saunders, who died Sept. 13th, was one of the leading English promoters of botany and entomology, being unequaled as a patron of natural science. He will be remembered by his Insecta Saundersiana and Refugium Botanicum, and a number of papers on entomology, botany and horticulture.

— We have neglected to record the death, in April last, of Dr. Hermann Loew, who has been so voluminous and painstaking a a writer on Dipterous insects, and has described and monographed so many American flies, chiefly in the publications of the Smithsonian Institution. His collections are in the Cambridge Museum.

— Prof. Cope has recently returned from an extended trip to the Pacific coast. Going and returning he made excursions into Colorado to the fields explored by him in 1873, and to the Jurassic beds of the Rocky mountains which have yielded the remains of the most gigantic of land vertebrata, the *Opisthocœla*. Desirous of ascertaining whether, after an interval of six years, a once productive locality would yield a new crop of fossils to the process of atmospheric erosion, he made an exploration of a part of the plains in the eastern section of the State. The region has been twice overrun and depopulated by the Cheyenne Indians since his expedition of 1873, hence a short stay was thought to be sufficient to accomplish the objects in view. On going over the ground, the topography showed moderate results of erosion. This had been sufficient to expose a great many fossils, several of them nearly complete skeletons. Such were found of species of *Hypertragulus*, *Poëbrotherium*, *Oreodon*, *Hoplophoneus*; there were also numerous jaws of *Temnocyon*, *Amphicyon*, *Dinictis*, *Mesodectes*, and many Rodentia. After a further successful search in the Loup Fork horizon, which yielded, among other things, *Pseudælurus intrepidus*, the outfit returned. The weather was cold; bread had to be cut with a hatchet, and water thawed out by the fire.

At the Jurassic beds, measures were taken for the further exhumation of *Camarasaurus*. Some fine specimens of a carnivorous Dinosaur of the genus *Hypsirophus* were obtained, and the greater part of the skeleton of *Amphicœlias altus* was secured.

Prof. Cope visited the Lower Miocene beds of the John Day region of Oregon, the scene of many recent explorations. His party had had excellent success, and had nearly exhausted the locality. Among other interesting specimens, they had obtained crania of five species of *Felidæ*, one of them a true *Machærodus*, *M. strigidens* Cope, of small size; and others of older type and larger size, which are described below. The skull of the *Hoplophoneus platycopis* was observed by the members of the party (under J. L. Wortman) perched on a pinnacle of an almost inaccessible precipice, and several fruitless attempts to reach it were made. At length Leander Davis, an experienced collector, secured the prize, which is, so far as known, unique in Prof. Cope's collection.

The most remarkable species of fossil cat is the *Archælurus debilis* Cope, gen. et sp. nov. Generic characters: Dentition. I. $\frac{3}{3}$, C. $\frac{1}{1}$, Pre-m. $\frac{4}{3}$, M. $\frac{1}{2}$; mandible with the anterior face of the symphysis separated from the lateral face by an angle which is not produced downwards. Superior sectorial without anterior lobe; inferior sectorial with heel. The characters place *Archælurus* at the base of the *Felidæ*, showing that it is the most generalized form yet known, and about equally related to the feline and Machærodont series. Char. specif.: General structure of the jaws, weak; superior canine, small, little compressed, with

an acute posterior edge which is not serrulate; first premolar in each jaw, one rooted; second inferior premolar, large; sectorials large; diastemata very short; alveolar border below the inferior sectorial and tubercular teeth everted, forming a large osseous callus which has a free inferior and posterior margin, the latter rising into the base of the coronoid processes; zygomata slender; postorbital processes little prominent; front, wide, convex transversely. Length of cranium, m. .200; superciliary width, .052; zygomatic width, .124; length from orbit to superior incisors, .066; length of superior sectorial, .023; do of inferior molar series, .064; diameter of superior canine, .012. About the size of the panther, or of the *Nimravus brachyops*.

Hoplophoneus platycopis Cope, sp. nov. This is the largest sabre-tooth discovered in North America. It is twice the bulk of the *H. primævus* Leidy, and differs from that species and the *H. occidentalis* in the relatively large size of the premolar teeth, which are less obliquely placed than in the latter. The first superior premolar is very small; the canine is large and compressed as in the species of *Machærodus*, and has serrulate posterior and anterior cutting edges. Inferior incisors with conic crowns. The symphysis is very deep in consequence of the large development of the inferior flares for the canines. Sagittal crest making a very steep angle with the front. Total length of cranium, m. .280; zygomatic width, .192; length from orbit to superior incisors, .095; length of superior sectorial, .025; of inferior do, .022; do of inferior molar series, .055; length of crown of superior canine, .060; width of do. at base, .026. This skull is one-sixth smaller than that of the Bengal tiger (*Uncia tigris*).

— The Permanent Exhibition of Philadelphia has received a temporary set-back in consequence of the issuing of an order for the removal of its building by the Park Commissioners. This extraordinary proceeding was the work of a majority of a mere quorum of that body, who met during the summer months while the remaining members of the commission were away from the city. The action of these men reminds us of that of Judge Hilton, of the New York Central Park, who destroyed Waterhouse Hawkins' restorations of extinct animals, and razed the building that was to contain them. The press of Philadelphia have unanimously condemned the commission, and demanded the continuance of the exposition.

— Thos. G. Gentry is engaged on a work on the fertilization of plants by insects, based on observations made in Pennsylvania and New Jersey.

— Prof. D. S. Jordan is preparing a work on the fishes of North America.

— Prof. O. B. Johnson, of Salem, Oregon, can furnish well prepared specimens of the fauna of Oregon at reasonable rates.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE NATIONAL ACADEMY OF SCIENCES.—The academy held its semi-annual meeting in New York, Oct. 28–30, 1879, in the new building of Columbia College, under the presidency of Prof. William B. Rogers. In opening the meeting, Prof. Rogers made the following references to the recent discoveries in science:

"In all branches of discovery we seem to be catching the clews of far-reaching thought, that stretch out where, as yet, no man's foot has trodden. As among some of the most recent of these may be instanced the evidence, amounting almost to proved assurance, by which Prof. Whitney places the existence of man at least as far back as the Pliocene era. We have the researches of Prof. Lockyer, almost demonstrating that substances hitherto regarded as elements can be regarded as compounds, and indicating that all matter may be ultimately resolvable into simple forms. There are the marvelous displays of what has been called the 'radiant force' of matter, as shown in the experiments of Prof. Crookes with new varieties of the radiometer. New ranges of profound inquiry are opening before us in the directions indicated by electrical inventions, such as the microphone and the telephone."

The following papers were read on subjects connected with biology and geology and anthropology: Original researches reported in the second medical volume of the medical and surgical history of the war of the rebellion, by J. J. Woodward; Some observations on the structure of the human brain, by J. C. Dalton; Some remarks on a new map of the Catskill mountains, and on the topographical relations of that mountain group to the adjacent regions of the Appalachian system, by A. Guyot; On the glycogenic function of the liver, and On old river-beds of California, by Joseph Le Conte; On some new and remarkable forms of Crinoidea from the lower Helderburg formation, and Notes on the *Lycoperdites vanuxemi* and allied forms, by James Hall; On the vegetation of the Atlantic coast of North America in the Cretaceous age, and On some interesting deposits of gold and silver ores in Utah and Colorado, by J. S. Newberry.

Prof. Guyot, in the course of his remarks on the Catskill mountains, distributed copies of his new map among the members especially interested. His object was to call attention to the geological problems exhibited by the Catskill plateau. He did not regard the carving of the mountains as glacial work, though the evidence of glacial scratches was not wanting. The process which had taken place, he thought, was an elevation of the whole district. But at the time of that rise the Adirondack formation was already in position, and by it the Catskill plateau was squeezed as it rose. The mountains which now occupy the place of that plateau were left by erosion, their valleys being carved

out by rivers. Prof. James Hall, in the discussion that followed, expressed himself as delighted with the adhesion of so good an observer as Prof. Guyot to this theory of the formation of mountains by erosion, and not by their separate upheaval. Prof. Rogers described an instance where one of the Shenandoah mountains could scarcely have been formed by a separate upheaval, for all its strata were horizontal from bottom to top; but the surrounding region was full of the evidences of disturbance.

Appalachian Mountain Club, October 8.—Mr. W. Wells read a paper on the new paths at Waterville, N. H.; Prof. C. E. Fay gave an account of the connection of the Portland White Mountain Club with Mt. Carrigan; President Niles spoke of the mountain studies of the late Violet-le-Duc; Prof. A. Geikie, of Edinburgh, was present, and addressed the meeting.

Boston Society of Natural History, October 15.—Prof. E. S. Morse read some archæological notes on Japan, and Mr. W. O. Crosby remarked on distorted pebbles in Conglomerate from the Brighton district of Boston.

Proceedings of Middlesex Scientific Field Club, Malden, Mass., November 5.—Frank S. Collins read notes on the marine Algæ of Middlesex county, Mass, in which twenty-nine species and one variety were enumerated. Among those new or rare in this locality were *Ralfsia clavata* Cronan, *Enteromorpha clathrata* Grev., var. *prostrata*, *Cladophora expansa* Kutz., *Rhizoclonium riparium* Harvey, and *Spirulina tenuissima* Kutz. The county has no coast line, and all collections were made in a small stream flowing into Mystic river. H. L. Moody read notes on the Asters, enumerating twenty species and two varieties collected in the county.—*Geo. E. Davenport, Cor. Sec'y.*

California Academy of Sciences, November 3.—The regular fortnightly meeting was held Nov. 3d. B. B. Redding occupied the chair. F. Slate, Mrs. T. H. Hittell, Oscar T. Barron, Hon. John H. Sanders. Frederick Ludemann, C. A. Webb and C. E. Locke were elected members of the association. In the absence of Prof. Davidson, who was to have addressed the association, Prof. Cope, who was present was invited to speak. The invitation was accepted, and the gentleman spoke at some length on several points in the palæontology and zoölogy of California. He first exhibited the skull of a large bear, found by J. A. Richardson in a cave in Shasta county, on the McCloud river. This specimen was said to belong to a species hitherto unknown, which resembles the bear of the pampas of Buenos Ayres. The California cave bear is so far distinct from the existing bears as to make it necessary to refer it to a distinct genus, which is probably the same as that to which the pampean bear belongs. Prof. Cope named it *Arctotherium simus.* It was as large as the grizzly

bear, and is peculiar in its short muzzle and bull-dog face. The speaker next exhibited a specimen of a lizard from the museum at the university at Berkeley, which was collected by Dr. J. G. Cooper, of the Geological Survey of this State. He stated that it was a new species of a little-known genus (named Xantusia by Baird), and formed an interesting addition to the herpetology of California. He named it *Xantusia riversiana*, in compliment to Mr. Rivers, of the University of California. Prof. Cope next called attention to a pair of feet of a deer belonging to the Academy, which were sent from Mendocino county. Each of these possessed but one central toe and hoof, instead of the usual pair. The speaker stated that the toes of the hinder feet were united throughout, and were so far developed beyond the usual point attained by the ordinary ruminant. The toes of the fore limb were different, one only being continued to the hoof, all the others being rudimental. "On the Hog-wallow Land of the San Joaquin valley," a very interesting paper, was read by Judge Hastings, and gave rise to considerable discussion. The title refers to the mound-lands common on the Pacific coast, such as occur at San Diego, on the Sacramento, Columbia, etc.

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SELECTED ARTICLES IN SCIENTIFIC SERIALS.

BULLETIN OF THE U. S. GEOLOGICAL AND GEOGRAPHICAL SURVEY OF THE TERRITORIES, VOL. V, NO. 2.—September 6. On the Coatis, by J. A. Allen. On the present status of *Passer domesticus* in America, with especial reference to the Western States and Territories, by Dr. Elliott Coues. The Laramie group of Western Wyoming and adjacent regions, by A. C. Peale. On Lithophane and new Noctuidæ, by A. R. Grote. Palæontological Papers, No. 11.—Remarks upon certain Carboniferous fossils from Colorado, Arizona, Idaho, Utah, and Wyoming, and certain Cretaceous corals from Colorado, together with descriptions of new forms, by C. A. White; The so-called Two-ocean pass, by F. V. Hayden; On the extinct species of Rhinoceridæ of North America and their allies, by E. D. Cope. Second installment of American Ornithological Bibliography, by Elliott Coues.

QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.—October. On some points in the development of the common newt, by W. B. Scott and H. F. Osborn. The structure of *Haliphysema tumanowiczii*, by E. R. Lankester (is not a sponge but a Protozoön). *Lithamœba discus*, one of the Gymnomyxa, by E. R. Lankester. On the structure of the vertebrate Spermatozoön, by H. Gibbes.

THE GEOLOGICAL MAGAZINE.—October. On the classification of the British Pre-cambrian rocks, by H. Hicks. Origin of pipe ore, by J. P. Lesley.

The Fourteenth Year

— OF —

THE AMERICAN NATURALIST:

A POPULAR ILLUSTRATED MONTHLY MAGAZINE OF NATURAL HISTORY AND TRAVEL.

ANNOUNCEMENT FOR 1880. (VOLUME XIV.)

THIS journal of popular Natural Science is published by Messrs. McCALLA & STAVELY, Philadelphia, Pa., under the editorial management of Dr. A. S. PACKARD, Jr., and Prof. E. D. C[...] with the assistance of eminent men of science. The typographical dress and illustrati[...] have heretofore given character to this magazine will be sustained, and it will be of a thor[...] popular nature, so as to interest the general reader as well as the young naturalist. It will co[...] to be a journal of science-education and for the use of science-teachers.

Each number of the NATURALIST contains carefully written articles on various scientific [...] and, in addition, departments of *Recent Literature, Botany, Zoölogy, Anthropology, Geo[...]* *Palæontology, Geography and Exploration*, and *Microscopy*. The department of Birds and Ma[...]mals is edited by Dr. ELLIOTT COUES, U. S. A., and that of Microscopy, by Dr. R. H. WA[...] Troy, N. Y. The Department of Geography and Travels is edited by ELLIS H. YARNALL, E[...] Prof. O. T. MASON will continue his monthly summaries of Anthropological News, and w[...] the Department of *Anthropology*. Arrangements have been made to report the *Proceedings of Scientific Societies* with great promptness. A Digest of the *Contents of Foreign Scientific Journals and Transactions* will also be given each month, together with the *Latest Home and For[...] Scientific News*.

The attention of publishers and teachers is called to critical notices of scientific books, to which especial attention will be given.

A new feature and one which will render THE NATURALIST most useful to American scie[...] and students of science, are summaries of progress made during the preceding year (1879 [...] ent departments of science. Reviews of progress in *Geology* will be furnished by Prof. T. STER[...] HUNT; in *Botany* by SERENO WATSON, Esq.; in the study of *Mammals* and *Birds* by Dr. ELLIOT[...] COUES, U. S. A.; of *Fishes* by Prof. THEODORE GILL; of *Crustacea* by Mr. J. S. KINGSLEY[...] of *Mollusca* by Dr. W. H. DALL, and of other classes by the Editors; Prof. C. A. WHITE w[...] report on *Invertebrate Palæontology;* Prof. OTIS T. MASON will prepare a report on progre[...] *American Anthropology* during 1879. American *Geography and Explorations* will be rep[...] upon by ELLIS H. YARNALL, Esq., and American *Microscopy* by Dr. R. H. WARD.

Original articles or notices by over fifty of our leading naturalists have appeared in the vo[...] for 1878 and 1879, among which occur the following names:—

DR. J. M. ANDERS,
MR. ARTHUR E. BROWN,
MR. W. W. BAILEY,
PROF. W. J. BEAL,
PROF. ALFRED W. BENNETT,
MR. W. O. CROSBY,
DR. ELLIOTT COUES,
HON. J. D. COX,
DR. W. H. DALL,
MR. G. E. DAVENPORT,
PROF. O. A. DERBY,
DR. FRANCIS DERCUM,
MR. F. M. ENDLICH,
PROF. PERSIFOR FRAZER,
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